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A multivariate analysis of the effects of academic performance and graduate education on the promotion of senior U.S. Navy Officers

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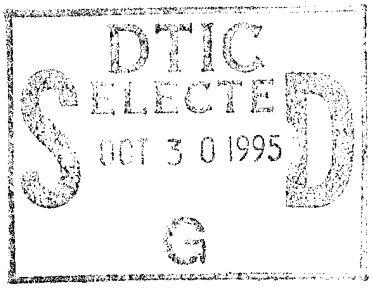

THESIS

A MULTIVARIATE ANALYSIS OF THE EFFECTS OF ACADEMIC PERFORMANCE AND GRADUATE EDUCATION ON THE PROMOTION OF SENIOR U. S. NAVY OFFICERS

by

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June, 1995

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Ordinary least squares (OLS) and maximum likelihood logit regression models were employed to estimate the probability of being promoted to these two ranks. The findings reveal that graduate education and academic performance have positive effects on promotion probability for some, but not all, of the communities over the various time periods.

Recommendations for further study are included.

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A MULTIVARIATE ANALYSIS OF THE EFFECTS OF ACADEMIC PERFORMANCE AND GRADUATE EDUCATION ON THE PROMOTION OF SENIOR U.S. NAVY OFFICERS

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ABSTRACT

This thesis develops multivariate models to estimate the effects of undergraduate academic performance and fully-funded graduate education on promotion to the ranks of Commander (O-5) and Captain (O-6) in the U. S. Navy. Using data extracted from the Officer Promotion History Files, two sample populations were selected for analysis: officers who appeared before the Commander promotion boards between fiscal years 1981 and 1994, and those who appeared before the Captain promotion boards during this same period. These data sets were further categorized into five warfare communities and two separate time periods; the period between 1981-1989 (the pre-drawdown), and the period between 1990-1994 (the drawdown).

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Recommendations for further study are included.

TABLE OF CONTENTS

I. INTRODUCTION

I reaffirm the investment in graduate education of selected officers to be a strategic requirement for the Navy. With today's technological, managerial, political, and economic complexities, the need for graduate level expertise has never been greater. Educating officers in specific subspecialties greatly increases operational readiness and, as a corollary benefit, develops the intellectual diversity and capacity that enhances the total professional performance of our officer corps. Our investment in graduate education must be pursued as a priority even in the face of competing demands and declining resources. (CNO, 1994)

-- ADM J. M. Boorda, Chief of Naval Operations, on graduate education policy.

A. BACKGROUND

Restating the Chief of Naval Operation's (CNO) position on graduate education is by no means a unique way to begin a thesis on this subject (Talaga, 1994), but it does provide an interesting launch point for this work. The top Navy leadership recognizes the importance of graduate education and remains committed to maintaining a certain portion of the officer corps with graduate level education subspecialty skills. This priority remains in spite of the fact that the Navy is faced with a declining budget and a need to downsize its force structure to man a leaner, more efficient war fighting machine. It can also be argued that this leaner force may require better educated officers and that the investment in these officers will benefit the Navy by providing leaders skilled in technical, analytical, and managerial skills.

There are mixed perceptions about graduate education, however, from officers within the different occupational specialties, known as warfare communities, in the Navy. Many feel that a graduate education will benefit their careers by providing an extra competitive edge over contemporaries vying for promotion spots. Others feel that time spent away from the chosen warfare specialty, the "opportunity costs" of attending a graduate school program for a period of two or so years, will make them less competitive in terms of promotion. The CNO recently has

attempted to clarify the issue, stating, "Promotion boards will be directed to consider graduate education as a positive influence on a Naval career during their deliberations" (CNO, 1994).

This thesis will examine the effects of graduate education on promotion to Commander and Captain prior to this renewed emphasis on graduate education. It will also serve as a baseline for further study as the CNO's positive emphasis on graduate education impacts both attitudes in the fleet and the results of promotion boards.

B. OBJECTIVES

This thesis will analyze the effects of graduate education and undergraduate academic performance on the promotion of officers to the ranks of Commander (O-5) and Captain (O-6). Data used for this study are based on the officer Promotion History Files for fiscal years 1981-1994, and are comprised of all officers who appeared before Commander and Captain promotion boards during this period. Five warfare communities are examined and compared over the entire 14 year period, and during two sub-periods: the period between 1981-1989, referred to here as the pre-drawdown period, and the period between 1990-1994, referred to as the drawdown period. By comparing these two time periods, it should be possible to discover any changes in the effects of education on promotion probability as the Navy moved from a period of growth to a drawdown.

This study is intended to answer a straightforward research question. Is there a statistically significant difference in promotion to the ranks of Commander and Captain for U.S. Navy officers with and without graduate education?

C. SCOPE, LIMITATIONS, AND ASSUMPTIONS

Five warfare communities are the subjects of this study. They are: Surface Warfare officers (SWO), Submarine Warfare officers , Pilots, Naval Flight Officers (NFO's), and a community of combined Fleet Support and Supply officers. Previous studies have, for the most part, focused on a single community. In this thesis, five communities will be will be studied separately; in addition, all communities will be

aggregated into a pooled data set. The available data cover a period of 14 years with one exception; information for the desired promotion boards during fiscal year 1985 was not available for this study. There is no reason to expect the 1985 data to exhibit radically different behavior than surrounding years, so this omission should not contribute any significant bias to the results. Promotion rate trends, displayed in Chapter III, seem to validate this assumption.

For the purposes of this thesis, graduate education is assumed to be a fully-funded, dedicated educational process, one that effectively removes the student from the community of his or her peers during the period of time spent pursuing a Master's degree. It does not include graduate degrees obtained through night study or correspondence course work, or any programs requiring the student to fund all or part of the costs.

D. ORGANIZATION OF THE STUDY

This thesis is divided into five chapters. Chapter II reviews pertinent literature and previous studies, both military and civilian, relevant to the effects of education on job performance. Chapter III defines the variables specified in the performance models, provides details on the data sets used, and describes the methodology used to develop the promotion models. Chapter IV presents the empirical analysis of the multivariate regression models. Chapter V summarizes the results and provides recommendations for further study.

II. LITERATURE REVIEW

A. EDUCATION AND NAVAL OFFICER PERFORMANCE

The first study reviewed was a piece by Donald J. Cymrot of the Center for Naval Analyses (CNA). This 1986 work, entitled "Graduate Education and the Promotion of Officers," was intended to assess the benefit to the Navy of providing a graduate education to its officers. Cymrot used promotion, being selected for the next rank or paygrade in the military, as a measure of productivity. If an officer advanced more rapidly through the system or ultimately achieved a higher rank than his or her peers, the officer was considered to be more productive. Cymrot was able to evaluate in monetary terms this relative change in productivity using the basic pay tables for officers in the study group (1985) because salaries for military officers are, for the most part, tied to rank. This monetary value was the marginal benefit associated with an additional graduate educated officer.

Three types of variables were used to explain promotion in this study: personal characteristics, previous experience and performance indicators, and Navy structural variables. The personal characteristic variables were graduate education, age, sex, and race. Graduate education was the focus of the study, and was expected to have a positive influence on promotion. The other three demographic variables were included to control for other factors that may influence promotion. The previous experience and promotion variables were time-in-rank and service continuity. Time-in-rank indicates the speed at which an officer progresses through each paygrade and service continuity controlled for an expected productivity difference between officers who left the service and returned as compared with those who remained in the military. Cymrot also used the time-in-rank variable to control for potential selectivity bias. He felt a selectivity problem could arise because one of the criteria for selection for graduate study is promotability. Because only a very small percentage of officers is selected for promotion "out of zone", meaning promotion earlier or later than the normal career

point, the time-in-rank variable probably does not adequately quantify a difference in productivity. The Navy structural variables were essentially community (occupational specialty) categories: restricted line, staff, and unrestricted line.

As a result of his empirical analysis, Cymrot found the effect of graduate education to be positive and statistically significant for all ranks until selection for flag officer. Specifically, he found graduate education increased the probability of promotion to Commander by 10.6 percentage points, and promotion to Captain by 16.5 percentage points.

William R. Bowman produced a study that was similar in many ways entitled "Do Engineers Make Better Naval Officers?" Although his focus was on undergraduate vice graduate education, he utilized multivariate regression procedures (LOGIT) to estimate the effects of causal factors: undergraduate major and academic performance (GPA), along with control factors such as marital status, race, having children, and fleet experience (ship type and occupational code), on a dependent variable representing superior performance. As the title suggests, Bowman was investigating the effects of United States Naval Academy (USNA) graduates' having an undergraduate engineering degree, as opposed to another undergraduate degree, on performance or, what he terms, the "Rickover hypothesis". He was referring to Admiral Hyman Rickover, the "Father of the Nuclear Navy," who was a strong proponent of eliminating any non-technical curricula from a prospective Naval officer's undergraduate education. This hypothesis implies that in the highly technical, modern Navy, an officer with an academic background in engineering is more likely to be evaluated as a superior performer. The sample population for this study was made up of graduates of the U.S. Naval Academy between 1976 and 1980, who selected the surface and submarine warfare communities upon graduation. The data were compiled from four sources: USNA admission records, the 1986 Officer Master and Loss files (Defense Manpower Data Center, Monterey), and fitness report data maintained by the Navy Personnel Research Development Center (NPRDC). Bowman found that the

Rickover hypothesis was not supported by the data. Neither undergraduate major nor undergraduate academic performance were significant determinants of officer performance, with one notable exception. For this sample population, having a management/economics undergraduate major (relative to an engineering major) increased the probability of attaining superior officer performance in the conventional Navy by 24.1 percent (Bowman, 1990).

In his Master's Thesis, "An Analysis of Surface Warfare Officer Measures of Effectiveness as Related to Commissioning Source, Undergraduate Education, and Navy Training," Joseph Nolan examined Surface Warfare officers from three commissioning sources; USNA, the Navy Reserve Officer Training Corps (NROTC), and Officer Candidate School (OCS). He selected those officers who appeared before the Lieutenant (O-3) promotion boards from 1981 to 1985 and those who appeared before the Lieutenant Commander (O-4) boards between 1985 - 1990 and modeled their performance, as evidenced by retention, promotion, and achievement of early professional qualifications, on background factors such as personal demographics, undergraduate education, college selectivity, Navy experience, and Navy training. The models were multivariate LOGIT models estimated by maximum likelihood techniques and demonstrated that background factors were important in attaining his selected measures of performance. Specifically, a high undergraduate GPA, superior undergraduate academic performance in science and engineering courses, and early professional qualifications provided statistically significant and positive effects on promotion to LT (O-3) and to LCDR (O-4).

Another Master's Thesis, "An Analysis of the Impact of Graduate Education on the Performance and Retention of General Unrestricted Line Officers" (Jordan 1991), modeled the effect of graduate education and background factors on promotion to the ranks of Lieutenant Commander (O-4) and Commander (O-5). The focus group for Jordan's work was the General Unrestricted Line community, which has since become the Fleet Support community. The Officer Promotion

History File and Officer Master Loss File for fiscal years 1981 through 1990 were utilized, creating sample populations of 1,040 and 404 observations for the LCDR and CDR promotion models, respectively. Jordan also used multivariate LOGIT techniques and found that graduate education had a positive impact on the probability of promotion to LCDR, but no significant effect promotion to the rank of CDR.

Michael Talaga authored a 1993 Master's Thesis entitled "A Multivariate Analysis of the Effects of Graduate Education on Promotion and Retention of Surface Warfare Officers." This study analyzed the effects of background and experience data on all Surface Warfare officers appearing before the Lieutenant (O-3) selection boards between fiscal years 1981 and 1985, and the Lieutenant Commander (O-4) selection boards between 1986 and 1990. Talaga used two measures of performance; promotion to LCDR and performance on LT fitness reports, as dependent variables for his performance models which were estimated with non-linear maximum-likelihood LOGIT procedures. His chosen explanatory variables covered a wide range of personal demographic, Navy experience, and academic factors. Some of these included sex, race, marital status, having dependent children, commissioning source, undergraduate academic performance (GPA), college quality, and graduate education.

Talaga found that officers with a fully-funded graduate degree were promoted to the rank of LCDR at a statistically significant, 11.6 percent higher rate than their peers without the additional education. He also found significant positive effects for gender in that females were 45.4 percent more likely to be promoted than males. Those officers who were married with children were 9.2 percent more likely to promote than single officers. Because of the similarity between Talaga's work and the research in this thesis, a comparison of his results with the results of current models on Surface Warfare officers is provided in Chapter IV.

B. EDUCATION AND CIVILIAN JOB PERFORMANCE

Some civilian studies also have examined the relationship between education attainment and performance on the job, normally using data from a single corporation. These studies are useful in terms of specifying the performance models to be estimated in this thesis in examining the effects of graduate education.

"Academic Achievement and Job Performance" is a study published by David Wise in 1975. It examines the effects of academic achievement and other personal characteristics on job productivity for college graduates working in a large corporation. Wise's review of the literature at the time indicated that academic achievement and job performance are not related for many occupations, even though the academic criteria may be used to select (screen) individuals into occupations.

Wise used a population of approximately 6,800 to select a sample of 1,300 white, male, college graduates who were hired before 1968 and were no older than 30 years old when hired. This age requirement effectively controlled for the effects of prior experience on performance. The performance measure chosen as a dependent variable for the study was salary, the effects on which were estimated using a linear probability (ordinary least squares) model. Chosen explanatory variables included; academic performance (GPA), quality of college attended, undergraduate major (technical or not), graduate education if attained while employed by the firm and not before (which is relevant to the Navy environment), and a socioeconomic index that encompasses personal background information.

Wise found that performance (salary) was related to many of his explanatory variables at statistically significant levels. Salaries of individuals with high grade point averages from selective colleges increased at nearly twice the rate of those with poorer academic performance from less selective schools. Graduate education provided a positive return on salary, but it was only significant if the individual was ranked in the top third of his graduate school class. An engineering undergraduate degree increased the rate of salary increases by nearly 3.9 percent, while liberal

arts and business degrees were associated with a slower salary growth rate. This would seem to lend credence to the "Rickover hypothesis" which was previously discussed.

In the final study reviewed, "Graduate Degrees and Job Success: Managers in One U.S. Corporation," Jennie Woo estimates the effects of various graduate degrees on four measures of productivity: annual salary, change in salary, supervisor's rating, and probability of promotion. She cites previous studies that found graduate education had positive effects on earnings, but questions whether or not this represents an increase in productivity. By choosing other measures of performance, she is able to control for the effects of her explanatory variables on salary. Woo used ordinary least squares techniques to estimate parameters for equations containing the first three productivity measures, and maximum likelihood LOGIT estimation for equations containing the promotion probability variable.

Woo found that a graduate degree did provide a greater annual salary advantage, although she attributes the advantage to the higher grade level that one reaches (or is initially assigned to upon entry) as a result of obtaining graduate education. Graduate education also positively affects the change in salary, even when controlling for grade level and supervisor ratings. Comparisons between the effects of graduate education on salary and other direct measures of performance are provided, and indicate that additional education (Bachelor's or Master's degree) and experience actually provide negative effects on receiving a high supervisor performance rating or promotion, suggesting that education or experience do not seem to be associated with better job performance (Woo, 1986). Unfortunately, there appear to be numerous flaws in this study. Unlike Wise, she includes all education levels in her study population, ranging from high school dropouts to individuals with doctorates. High school dropouts and high school diploma graduates are the omitted category in her models, and the observed negative effects of a college degree and greater experience fly in the face of a considerable body of research. Her sample also includes individuals who enter the corporation

with a graduate education. This prevents analysis of increased productivity as a result of obtaining a graduate degree after joining the firm. Finally, she excludes an important group of employees from her analysis, those who left the corporation. Her assumption that these individuals probably had lower productivity, lower promotion rates, and possibly lower earnings is unsupportable, as an argument could easily be made that more productive people have more choices in employment, and are likely to leave for job opportunities that provide a higher return on their own investment in human capital. It is difficult to find plausibility in her conclusions that obtaining a college education, a graduate degree, or having more experience are actually productivity detractors. Mehay and Bowman carefully critique this study in "Graduate Degrees and Job Performance: Evidence from Military Officers" (Mehay, 1995).

These studies serve as a framework for specifying the estimating models and as a baseline for comparing and evaluating the effects on promotion estimated in this thesis. This work generally finds that academic performance and graduate education will positively influence promotion in the Navy.

III. DATA AND METHODOLOGY

A. VARIABLE DEFINITION

1. Dependent Variables

A single statistical model was specified for this analysis. This model regressed a dependent variable, which served as a proxy for performance, on a number of selected explanatory variables representing background and personal characteristics. For this promotion model, the dependent variable was a binary variable (PROMOTED), which took a value of one if the member was selected for promotion to the rank of Commander (O-5) in the Commander data set or promotion to Captain (O-6) in the Captain data set, and a value of zero if the member was passed over (not selected) for promotion. An officer's relative position with respect to the group of individuals being considered for promotion is referred to as his zone. When a particular cohort of officers is presented to the fiscal year's promotion board, they are said to be "in zone". Those not yet considered are termed "below zone" and those who have been considered but failed to be selected are "above zone". The variable PROMOTED measures promotion without regard to the number of appearances before the promotion board (usually limited to three). Although potential bias exists as "above zone" officers may be counted twice in the data, this represents only about 3 percent of the sample population for each rank being studied, an insignificant proportion. Note, however, that this approach does have the effect of lowering annual promotion rates below "official" Navy promotion statistics.

2. Independent Variables

The independent (explanatory) variables for the promotion model were chosen from the background and personal characteristics provided in the data base. They were chosen because of their use, in either identical or similar forms, in prior studies on graduate degrees and job success (Woo, 1986) and academic achievement and job performance (Wise, 1975). They also closely resemble

variables used in earlier research relating undergraduate and graduate education to the performance of officers in the U.S. Navy (Nolan, 1993; Talaga, 1994). The models are run on pooled data sets, as well as on data sets restricted to specific designators or certain time periods. In an attempt to maintain comparability, the same explanatory variables are used in all models, with a few exceptions. Because there are no female officers represented in the data sets within the Submarine officer community, the MALE variable is not applied to the promotion model for the SUB designator. Likewise, minorities and females are not well represented for some warfare groupings in the earlier years (pre-drawdown period) or for the senior (Captain) promotion boards. This representation improves as more women and minorities advance through the ranks into the drawdown period.

The first two explanatory variables are MALE and WHITE. Each takes a binary value of one if the observed member is male or Caucasian, or a value of zero if the member is female or a member of any other ethnic group, respectively.

The next explanatory variable, and the focus of this study, is FFGE. It is also a dummy (binary) variable and is derived from the 'Sponsor1' field of the Officer Promotion History Files. A value of "N" in Sponsor1 represents a Navy sponsored (fully-funded) graduate program which, in most cases, indicates attendance at the Naval Postgraduate School in Monterey, CA. FFGE, therefore, takes a value of one if the member has completed a fully-funded graduate education program and a value of zero otherwise.

Other factors that are likely to have some effect on whether or not an officer is selected for promotion are his or her undergraduate performance, the "quality" of the undergraduate institution attended, and whether or not the undergraduate degree was in a technical field of study (Wise, 1975; Talaga, 1994). These education attributes are accounted for by the binary variables SCHOLAR , HIQUAL, USNA, and TECHMAJ. SCHOLAR takes a value of one if the member's undergraduate grade point average was 3.2 or higher, otherwise, it takes a value of zero. HIQUAL takes a value of one if the undergraduate institution the member

attended was rated in the two highest categories, "Most Competitive" or "Highly Competitive," in Barron's Profiles of American Colleges. If Barron's evaluates the school as "Very Competitive", "Competitive", "Less Competitive", or "Special", the HIQUAL variable takes a value of zero. The U.S. Naval Academy is rated by Barron's as a "Most Competitive" school. However, because of the possibility that being a Naval Academy graduate may influence promotability for reasons other than the school's academic quality, such as early leadership training, it is isolated from the HIQUAL variable and becomes its own binary variable, USNA. TECHMAJ takes a value of one if the undergraduate degree earned is in any engineering field or in one of the math intensive sciences, such as physics, chemistry, mathematics, operations research, or microbiology. TECHMAJ takes a value of zero otherwise.

One other explanatory variable believed to have an impact on promotability is whether or not an officer had prior service as an enlisted member. To control for this proxy for experience, the binary variable PRIENL takes a value of one if the member served as an enlisted person for at least 24 months prior to his or her date of commission, and a value of zero otherwise.

Five categorical variables were created to identify occupational specialties within the larger data sets. These are known in the Navy as "designators" and are used to control for the differences in promotion across communities. Officer career paths tend to differ by community. Also, the Navy promotes to fill vacancies, which may differ by community in a given fiscal year. These variables are SWO, SUB, PILOT, NFO, and SUPPORT, and represent the Surface Warfare (surface ship), Submarine Warfare (submarine), Aviation (separate variables for Pilot and Naval Flight Officer), and Fleet Support and Supply (combined) communities, respectively.

Definitions of the dependent, categorical, and independent variables can be found in Table 1.

DEPENDENT VARIABLE	DESCRIPTION
PROMOTED	= 1 if promoted to the rank identified by the data set = 0 if passed over
DESIGNATORS	
SWO	= 1 if Surface Warfare Officer = 0 otherwise
SUB	= 1 if Submarine Officer = 0 otherwise
PILOT	= 1 if Naval Aviator (Pilot) = 0 otherwise
NFO	= 1 if Naval Flight Officer = 0 otherwise
SUPPORT	= 1 if Fleet Support or Supply Officer = 0 otherwise
INDEPENDENT VARIABLE	**DESCRIPTION**
PERSONAL DEMOGRAPHICS	
MALE	= 1 if male = 0 otherwise
WHITE	= 1 if Caucasian ethnicity = 0 otherwise
MARRIED	= 1 if married with no children = 0 otherwise
KIDS	= 1 if married with dependent children = 0 otherwise
EDUCATIONAL EXPERIENCE	
SCHOLAR	= 1 if undergraduate grade point average was greater than 3.2 on a 4.0 scale = 0 otherwise
HIQUAL	= 1 if undergraduate degree received from a school rated as "Most" or "Highly" competitive in Barron's Profiles of American Colleges = 0 if USNA graduate or Barron's rating of "Very Competitive", "Competitive", "Less Competitive", or "Special"
FFGE	=1 if completed a fully funded graduate education program (Naval Postgraduate School) = 0 otherwise

USNA	= 1 if Naval Academy graduate = 0 otherwise
TECHMAJ	= 1 if engineering or math intensive science undergrad degree program = 0 otherwise
PRIENL	= 1 if served as an enlisted member at least 24 months prior to being commissioned = 0 otherwise

TABLE 1. Description of Dependent and Independent Variables

B. DATA SETS

The data used in this thesis were obtained from code Pers-10 in the office of the Chief of Naval Personnel. The data set is based on the Officer Promotion History Files which were provided to Professors William R. Bowman at the U.S. Naval Academy and Stephen Mehay at the Naval Postgraduate School. The files contain information on all U.S. Navy officers who appeared before promotion boards between fiscal years 1981 and 1984, and between 1986 and 1994, with the exception of Medical Corps and Judge Advocate General (JAG) Corps officers. Fiscal year 1995 data on Commander and Captain promotion boards were not available for this study. Since this thesis deals specifically with officers being considered for promotion to the ranks of Commander (O-5) and Captain (O-6), two separate data sets were created by grouping those officers who appeared before the O-5 and O-6 boards, respectively. Unlike previous studies which focused on a single warfare (occupational) specialty, this study will look at the results of models run on the full data sets, as well as separate models run on each of five warfare communities for each promotion. Additionally, these models will be estimated for the full period, then for two sub-periods. The first sub-period lies between fiscal years 1981 and 1989 and is referred to as the pre-drawdown period. The promotion decisions for this period will be compared with outcomes as the Navy "rightsizes", from fiscal years 1990 to 1994 (the drawdown period). This

disaggregation will allow a test of whether the determinants of promotion have changed during the drawdown.

1. Commander Data Set

The Commander data set consists of 12,372 observations of 206 variables. Of all officers who appeared before the O-5 promotion boards over the 13 years considered, 8,557 were selected for promotion to the rank of Commander (O-5), an overall promotion rate of 69 percent. However, the promotion rates varied from a high of 82 percent in FY81 to a low of 63 percent in FY93. Further specifics about this data set are contained in Table 2. As Table 2 shows, most of the candidates were white males and 21 percent had fully-funded graduate degrees. Over 15 percent had undergraduate grade point averages (GPA) greater than 3.2 and 33 percent of the sampled officers attended highly selective colleges (USNA included) as undergraduates. The U.S. Naval Academy was the commissioning source for 24 percent of this group and 29 percent of these Commander aspirees had undergraduate degrees in technical fields. Almost 14 percent of the sampled population had served in an enlisted status before receiving an officer's commission. Sixteen percent were married with no children and another 75 percent had dependent children.

2. Captain Data Set

The Captain data set consists of 4,616 observations and 206 variables. Of these candidates, 2,421 were selected for promotion to the rank of Captain (O-6) for an overall promotion rate of 52 percent. For this group of officers, the promotion rate varied from a high of 61 percent in FY83 to a low of 47 percent in FY94. Further specifics for this data set may be found in Table 3.

As presented in Table 3, the Captain data set is also predominantly male and white. Nearly 23 percent of its members have fully-funded graduate degrees and 13 percent had undergraduate GPA's above 3.2. The Naval Academy was again well represented with graduates comprising almost 29 percent of the group being studied.

VARIABLE	MEAN
Sample Population	N = 12,372
PROMOTED	.692
WHITE	.965
MALE	.932
FFGE	.219
SWO	.249
SUB	.099
PILOT	.288
NFO	.180
SUPPORT	.184
SCHOLAR	.155
HIQUAL	.091
USNA	.243
TECHMAJ	.294
PRIENL	.137
MARRIED (NO KIDS)	.161
KIDS	.752

TABLE 2. The Commander Data Set Variables and Means

Technical undergraduate majors were 22.8 percent of the sample and only 6.3 percent had served as enlisted members before commissioning. Nine percent of the sampled members were married with no children and 86 percent had dependent children.

3. Promotion Rates

Comparisons of promotion rates for both Commander and Captain data sets, by fiscal year, are provided in Figure 1 and Table 4. As Figure 1 shows, promotion rates have slowly declined during the downsizing period. This has occurred even though the Navy has been thinning its ranks by using early retirement and

separation bonuses, among other policies. Recall, too, that the measured promotion rate in this thesis is somewhat lower than the "official" 70 percent target success rate as the data here include some individuals each year who were passed

VARIABLE	MEAN
Sample Population	N = 4,616
PROMOTED	.524
WHITE	.984
MALE	.966
FFGE	.229
SWO	.260
SUB	.116
PILOT	.329
NFO	.147
SUPPORT	.148
SCHOLAR	.130
HIQUAL	.095
USNA	.287
TECHMAJ	.228
PRIENL	.063
MARRIED (NO KIDS)	.094
KIDS	.860

TABLE 3. The Captain Data Set Variables and Means

over in a previous year. In addition, the basis for computing promotion rates here is smaller than that used in official statistics because in constructing the primary data set for this thesis, observations were deleted when key variables were missing. Thus, the number of observations for Commander (O-5) promotions, for example, fell from 15,674 to 12,372 when these restrictions were applied to the sample. The annual promotion rates in the data set are consistent across years, but do not reflect "official" Navy promotion rates.

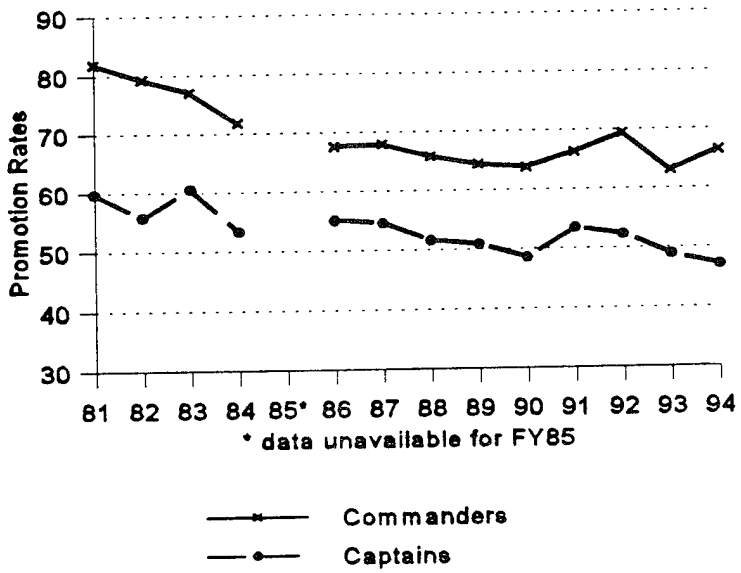

Figure 1. Promotion Rates by Fiscal Year for U.S. Navy Commanders and Captains

FISCAL YEAR*	Commanders	Captains
1981	.819	.598
1982	.793	.557
1983	.771	.606
1984	.718	.534
1986	.676	.551
1987	.679	.546
1988	.658	.516
1989	.644	.509
1990	.638	.486
1991	.663	.535
1992	.694	.522
1993	.631	.489
1994	.664	.471

Note: * fiscal year 1985 data unavailable for this study

Table 4. Promotion Rates for U.S. Navy Commanders and Captains (Fiscal Years 1981-1994)

C. METHODOLOGY

This thesis is intended to examine the effect of fully-funded graduate education and other factors on a naval officer's promotion to the rank of either Commander (O-5) or Captain (O-6). The binary nature of the dependent variable, PROMOTED, allows for estimation of multivariate models using both ordinary least-squares (OLS) and maximum likelihood procedures. In the first case a linear regression model is specified and estimated, while in the second a non-linear LOGIT model is estimated. In essence, it is assumed that promotion is a function of numerous background and demographic factors, many of which can be quantified from the data set in use. In this vein, the PROMOTE variable is regressed on each member's sex, race (white versus non-white), marital and dependent status, undergraduate academic performance, undergraduate institution's "quality", undergraduate major (technical versus non-technical), whether or not he or she served as an enlisted person before receiving a commission, and whether or not the individual possesses a fully-funded graduate degree.

Identical models were specified for each subset of the pooled data set, as sorted by warfare designator, as well as for the overall data set, to enable comparisons between officer communities and between each community and the entire sample population. The parameter estimates provided by the LOGIT model reflect the increase (or decrease) in the log of the odds ratio of being promoted, per unit increase in the explanatory variable being considered (Gujarati, 1988). Because each of the explanatory variables in the model are dummy (binary) variables, the change in the log of the odds ratio of being promoted is only seen when the observed member possesses the attribute (male, white, etc.) in question. A more understandable interpretation of these LOGIT results is the change in probability of being promoted, given the member has the attribute under consideration. There are two ways to determine this probability. The estimate may be obtained from the formula: $\mathbf{B}^*\mathbf{P}(1-\mathbf{P})$ where **B** represents the LOGIT parameter estimate for a given explanatory variable and **P** represents the probability of the

observation having the attribute under consideration for the overall sample (Gujarati, 1988). As an alternative, since identical linear probability models were specified, the parameter estimates derived as a result of the OLS regressions also approximate this result (the change in probability of promotion) and are provided in tables with the LOGIT estimates in the following chapter.

The members of the data sets were grouped not only by warfare designator, but by time periods as well. In an effort to identify differences in promotion success between those who appeared before promotion boards while the Navy was increasing its manning to fill positions in a 600-ship navy (the pre-drawdown period) versus the period after fiscal year 1989 while the Navy was downsizing to fill a more streamlined force of approximately 350 ships (the drawdown period), Chow tests were performed to compare differences in determinants between these two groups. Details of the procedure may be found in Gujarati (1988, p. 443) and the test results are provided in the following chapter.

IV. EMPIRICAL ANALYSIS

A. MULTIVARIATE ANALYSIS

As explained in the previous chapter, the promotion model was specified for all designators combined in each major data set (Commander and Captain) as well as for subsets of the data for each warfare community. These regressions were, in turn, run separately in an attempt to distinguish different behaviors during the pre-drawdown period as compared with the drawdown period. This chapter will first present some descriptive statistics for the data sets, and will then present the results of the multivariate regressions over the pooled years (FY1981-FY1994). The final section will provide a comparison of the parameter estimates between pre-drawdown and drawdown periods.

1. Preliminary Analysis of the Commander Data Set

The principal focus of this thesis was to identify the effects of graduate education and undergraduate academic performance on the promotion of U.S. Navy officers. Preliminary analysis of the data set reveals a significant percentage of the officers who appeared before the Commander promotion boards possess fully-funded graduate degrees (22%) and 16 percent exhibit superior undergraduate academic performance, which is defined as an undergraduate GPA greater than 3.2. This is presented for the entire data set as well as for individual warfare communities in Figure 2.

2. Parameter Estimates for the Commander Data Set (Pooled Years)

Both OLS and LOGIT models were estimated for the data set using promotion as the dependent variable. This section presents the overall results for the grouped warfare designators, as well as for the individual models run on each warfare community.

The parameter estimates for the LOGIT model on combined warfare designators are provided in Table 5, along with the associated signs, standard errors, and the OLS estimates. The OLS estimates are arguably the most easily

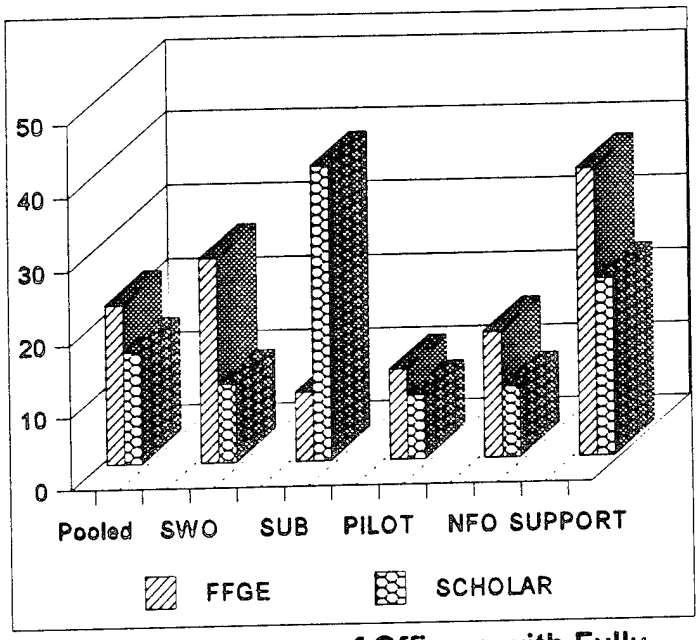

Figure 2. Percentage of Officers with Fully-funded Graduate Education and Superior Undergraduate Academic Performance (Commander Data Set).

interpreted results, as they closely represent the calculated change in probability associated with a one unit change in each of the explanatory variables. In this particular model, eight explanatory variables are statistically significant at a 0.05 level of significance in terms of their effect on promotion. Officers with a fully-funded graduate degree and those who had superior undergraduate academic performance have higher probabilities of being promoted to the rank of Commander by 8.7 and 6.6 percent, respectively. Likewise, higher probabilities of promotion are observed for those who are male, white, graduates of the U.S. Naval Academy, are married, or have at least one dependent child. As indicated by the negative values on their coefficient estimates, officers who served as enlisted members before receiving their commission, and those whose undergraduate degrees were in math-intensive science or engineering fields, were less likely to be promoted to O-5.

The likelihood ratio chi-square test statistic for this model, 339.833, tests the joint significance of all the explanatory variables included in the model. In this case, it is significant at the .005 level. The concordance ratio, in this case a value of .582, provides a measure of the predictive ability of the model. A Chow test was also performed, to compare the behavior of the pooled designator model with the specific community models. In this instance, the test suggests rejecting the null hypothesis, indicating that the regressions are not similar.

	LOGIT	OLS
Independent Variables	**Coefficient Estimate (Standard error)**	**Change in Probability**
MALE	0.1976* (0.0874)	0.043
WHITE	0.3532* (0.1131)	0.079
FFGE	0.4677* (0.0579)	0.087
SCHOLAR	0.3534* (0.0661)	0.066
HIQUAL	0.1292 (0.0792)	0.026
USNA	0.4606* (0.0559)	0.085
PRIENL	-0.6355* (0.0853)	-0.141
TECHMAJ	-0.0538 (0.0543)	-0.011
MARRIED	0.4009* (0.0881)	0.088
KIDS	0.5375* (0.0780)	0.114
LOGIT CHI-SQUARE (Likelihood Ratio test) : 339.833		
LOGIT Concordance Ratio : 0 . 582		
Note: * Significant at the 0.05 level		

TABLE 6. Parameter Estimates of the Commander Promotion Model for All Designators (Pooled Fiscal Years 1981-1994)

3. Preliminary Analysis of the Captain Data Set

Officers who appeared before the Captain (O-6) promotion boards between fiscal years 1981 and 1994 were selected for promotion at a rate of 52 percent. Of the total sample population, 23 percent had completed graduate degrees and 13 percent exhibited superior undergraduate academic performance (GPA>3.2). The FFGE and SCHOLAR percentages for combined designators and individual warfare communities are presented in Figure 3.

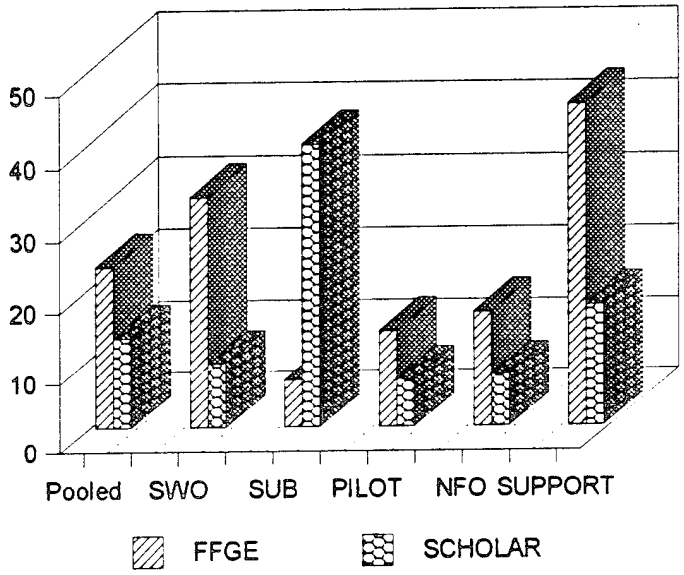

Figure 3. Percentage of Officers with Fully-funded Graduate Education and Superior Undergraduate Academic Performance (Captain Data Set).

4. Parameter Estimates for the Captain Data Set (Pooled Years)

Graduate education appears to lose its significance as an officer progresses from the Commander promotion board to the Captain promotion board. This may be due to the fact that promotion to the rank of Captain, for some warfare communities, is thought to be determined primarily by performance while serving

in a command position in the rank of Commander. This criteria is not necessarily mirrored for the Fleet Support and Supply community. As this section analyzes the models for pooled designators, the effect of FFGE in some communities may be lost in the aggregate.

As shown in Table 6, only four of the ten explanatory variables are statistically significant for this data set. The probability of being promoted to Captain appears to be positively influenced by undergraduate academic performance (7 percent difference), attendance at USNA (9 percent), and having dependent children (11 percent). Prior enlisted status was a detriment for promotion in this data set, as it was for the Commander data set, and reflects an 11.6 percent decrease in the probability of being promoted to Captain. All other explanatory variables were insignificant at a 95 percent confidence level (0.05 level of significance).

The likelihood ratio chi-square test statistic for this model was 62.666 and the concordance ratio was .515. Chow testing of this model also suggests rejecting the null hypothesis, therefore, the specific community models behave differently than the pooled designator model.

5. Parameter Estimates for Specific Warfare Communities (All Years)

A comparison of how the explanatory variables affect promotion for each of the warfare communities in the Commander data set is provided in Table 7. For the SWO and SUPPORT communities, graduate education is statistically significant and has a pronounced effect on promotion probability. For the Surface Warfare officer, having a graduate degree results in a 13.5 percent higher probability of promotion to the rank of Commander. Likewise, a Fleet Support or Supply officer could expect a substantial 23.4 percent advantage over peers who do not have a graduate education. Having dependent children produces positive effects for all five warfare designators and being a Naval Academy graduate is significant for each of the four warfare communities known as "unrestricted line" communities. The Naval Academy produces far more unrestricted line officers than Fleet Support

	LOGIT	OLS
Independent Variables	Coefficient Estimate (Standard error)	Change in Probability
MALE	-0.1045 (0.1876)	-0.026
WHITE	-0.0754 (0.2536)	-0.0185
FFGE	-0.0375 (0.0764)	-0.009
SCHOLAR	0.3007* (0.0976)	0.072
HIQUAL	0.2091 (0.1129)	0.052
USNA	0.3746* (0.0724)	0.092
PRIENL	-0.4732* (0.1917)	-0.116
TECHMAJ	0.0155 (0.0806)	0.004
MARRIED	0.2656 (0.1855)	0.065
KIDS	0.4509* (0.1663)	0.111
LOGIT Chi-Square (Likelihood Ratio Test): 62.666		
LOGIT Concordance Ratio : 0 . 515		
Note: * Significant at the 0.05 level		

TABLE 6. Parameter Estimates of the Captain Promotion Model for All Designators (Pooled Fiscal Years 1981-1994)

or Supply officers as a result of its admission requirements and a policy that only permits a graduating midshipman to enter one of the "restricted line" communities if he or she is not physically qualified for the unrestricted line. This may explain the lack of statistical significance for the USNA variable in the promotion model for the SUPPORT community.

	Community ***				
Independent Variables	SWO	SUB	PILOT	NFO	SUPPORT
MALE	-0.067	**	0.067	0.100	-0.006
WHITE	0.052	-0.185	0.180 *	0.026	0.045
FFGE	0.135 *	-0.038	0.002	-0.009	0.234 *
SCHOLAR	0.055 *	0.009	0.087 *	0.069	0.043
HIQUAL	0.057	0.092 *	-0.025	0.046	0.021
USNA	0.064 *	0.163 *	0.044 *	0.124 *	0.013
PRIENL	-0.141 *	-0.221 *	-0.055	-0.058	-0.136 *
TECHMAJ	-0.023	0.021	-0.035	-0.045	-0.115 *
MARRIED	0.078 *	0.142 *	0.131 *	0.112	0.044
KIDS	0.129 *	0.168 *	0.116 *	0.162 *	0.075 *

Notes: * Significant at the 0.05 level ** Not included in model because of no variance in representation

*** coefficients represent change in probability of promotion (from OLS estimates)

**** LOGIT model results may be found in Appendices

TABLE 7. Comparison of Parameter Estimates (OLS) for the Commander Promotion Model by Warfare Community (1981-1994)

Table 8 provides a comparison of promotion model parameter estimates for the Captain data set. These OLS coefficients are provided for each warfare designator over the entire 14 year period. Only five of the ten explanatory variables display a high degree of statistical significance for this model, suggesting that other factors, which are not accounted for in this model, are more likely to determine successful promotion to the rank of Captain.

The graduate education variable, FFGE, loses its statistical significance from the Commander model for all communities, with one exception. Fleet Support and Supply officers continue to benefit from obtaining a graduate degree, with a promotion probability 19 percent higher than officers without the degree. Recall that FFGE provided positive influence on both SWO and SUPPORT models for the Commander data set, and was statistically significant for the model on pooled Commander designators as well.

The USNA variable continues to positively influence promotion probability for the SWO and SUB communities, providing higher promotion rates of 8.6 and 13.9 percent, respectively. Although only significant for the Surface Warfare community, having served as an enlisted member before being commissioned exhibits a consistent decrease in likelihood for promotion.

	Community ***				
Independent Variables	SWO	SUB	PILOT	NFO	SUPPORT
MALE	**	**	-0.188	**	-0.124
WHITE	-0.100	0.618	0.166	0.112	-0.132
FFGE	0.023	-0.011	-0.038	-0.072	0.191 *
SCHOLAR	0.120 *	-0.004	0.029	0.102	-0.016
HIQUAL	0.026	0.030	0.099	0.084	0.019
USNA	0.086 *	0.139 *	0.022	0.083	0.006
PRIENL	-0.236 *	-0.146	-0.048	-0.232	-0.020
TECHMAJ	-0.009	0.045	-0.037	-0.186 *	-0.050
MARRIED	0.081	0.144	0.098	0.044	0.016
KIDS	0.135	0.163	0.120	0.193	0.045

Notes: * Significant at the 0.05 level ** Not included in model because of no variance in representation
*** coefficients represent change in probability of promotion (from OLS estimates)
**** LOGIT model results may be found in Appendices

TABLE 8. Comparison of Parameter Estimates (OLS) for the Captain Promotion Model by Warfare Community (1981-1994)

6. Comparison of Promotion Determinants in Pre-Drawdown and Drawdown Periods

One area that appears to have received little attention in previous studies relating to this subject is the potential change in promotion outcomes as the Navy's manning policies change during the downsizing of the force. Promotion rates for both data sets demonstrate a fairly steady decline over the 14 year period of this analysis, but fail to indicate the more subtle changes in determinants of promotion that may occur over time. This section will attempt to address these issues by

providing comparisons of pre-drawdown and drawdown promotion outcomes for the combined designators, as well as for individual communities. These comparisons will be verified statistically through the use of a Chow test (Gujarati, 1988). The null hypothesis (H_0) for this test is that the estimated coefficients are the same, in other words, there is no difference between the determinants for the two groups being compared. The results of the Chow test will allow for rejecting the null hypothesis, indicating that the groups behave differently, or failing to reject the null hypothesis, which indicates that the regressions may be similar.

Table 9 displays the parameter estimates for the OLS linear probability model for the combined warfare designators. For the Commander data set, six of the variables are significant during both periods. The positive impact of graduate education increases from 8.4 to 9.8 percent, possibly reflecting the emphasis placed on graduate education for officers by the Chiefs of Naval Operations over the last fourteen years. The effect of being a graduate of the Naval Academy also displays an increasing trend, increasing from a 6.6 to an 11.6 percent probability. The effects of undergraduate academic performance, being married, and having dependent children are all positive factors, but their effect on promotion probability lessens during the drawdown period. Prior enlistment decreases the probability of being promoted to Commander, and this effect becomes more pronounced during the later period.

Three of the remaining four variables change in significance. The college quality variable, HIQUAL is insignificant during the pre-drawdown period but becomes statistically significant during the later period, improving the probability of promotion by 8 percent. Likewise, MALE becomes significant and has a positive effect on promotion. WHITE, on the other hand, loses its significance during the drawdown period. Chow test results for this analysis indicate a rejection of the null hypothesis, suggesting that the two regressions are dissimilar.

Table 9 also shows results of the promotion models for combined designators in the Captain data set. The only variable that remains statistically

significant over both periods is USNA, although the positive effects decrease from 12.5 to 7.3 percent over time. Only three other variables display any significance during either period. Undergraduate academic performance (SCHOLAR) becomes statistically significant and increases the probability of promotion by 9 percent during the drawdown. The positive effects of having dependent children increases from 8.6 to 12.3 percent, and becomes statistically significant during the second period. Finally, prior enlisted service, which provides a 14.5 percent decrease in probability of promotion during the pre-drawdown, decreases promotion probability by only 9.7 percent and loses its significance during the drawdown. Chow tests on these models result in a failure to reject the null hypothesis, indicating that the regressions behave in a like manner.

	Commander Data Set		Captain Data Set	
Independent Variables	Pre-drawdown	Drawdown	Pre-drawdown	Drawdown
MALE	0.014	0.055 *	0.019	-0.039
WHITE	0.121 *	0.030	0.015	-0.033
FFGE	0.084 *	0.098 *	-0.038	0.009
SCHOLAR	0.097 *	0.050 *	0.044	0.091 *
HIQUAL	-0.007	0.082 *	0.037	0.060
USNA	0.067 *	0.116 *	0.125 *	0.073 *
PRIENL	-0.121 *	-0.142 *	-0.145 *	-0.097
TECHMAJ	0.000	-0.018	0.046	-0.014
MARRIED	0.089 *	0.087 *	0.012	0.098
KIDS	0.127 *	0.095 *	0.086	0.123 *

Notes: * Significant at the 0.05 level ** coefficients represent change in probability of promotion (from OLS estimates)
*** LOGIT model results may be found in Appendices

TABLE 9. Comparison of Parameter Estimates (OLS) for Pre-drawdown and Drawdown Periods. Commander and Captain Data Sets Combined Designators

An analysis of the pre-drawdown and drawdown periods for the Surface Warfare Officer (SWO) community is depicted in Table 10. A fully-funded graduate

education is a significant factor in both periods for the Commander promotion model. It increases the probability of promotion by 14.7 percent in the earlier period and continues this positive effect, although at slightly smaller (11.2 percent) rate during the downsizing. Having dependent children is a positive contributor to promotion at 13 percent and 12 percent over the respective time frames. Prior enlistment also remains a statistically significant negative factor, decreasing promotion probability by 14 and 12.8 percent in the two periods, respectively. Undergraduate academic performance increased promotion chances by 8.9 percent in the pre-drawdown period, but did not contribute significantly in the later period. Attending a high quality college, or the Naval Academy, improved promotion rates significantly in the early 1990's, by 10.3 and 11.1 percent, respectively. The Chow test on the models causes a failure to reject the null, suggesting similar behavior between the regressions.

A previous study of Surface Warfare officers used excerpts of the same data base utilized for this study and analyzed promotion behavior to the ranks of Lieutenant (LT) and Lieutenant Commander (LCDR) (Talaga, 1994). Talaga used data files containing background, Navy experience, and promotion selection board results for all officers going before the Lieutenant (O-3) board between fiscal years 1981 and 1985, and those going before the Lieutenant Commander board between fiscal years 1985 and 1990. Were he to have continued his analysis of these officers, his next group of subjects would coincide with the Surface Warfare officers who comprise the drawdown Commander data set. In other words, his cohort would include those Surface Warfare officers who appeared before the Commander promotion board between fiscal years 1990 and 1994. In light of this connection, it is possible to compare results of the Talaga study with the analysis in this thesis.

Six variables from Talaga's promotion model are similar to variables in this promotion model, and two of these were statistically significant. Talaga's FFGE variable exhibited a 13.6 percent increase in probability of promotion to the rank of LCDR and was statistically significant. Likewise, the drawdown Commander

FFGE variable here demonstrated a significant 11.2 percent increase in promotion probability. Another significant variable for LCDR promotion was married with children (MARCHILD), which increased promotion probability by 9.2 percent. Similarly, the drawdown KIDS variable increased promotion odds by 12.1 percent and was significant at the .05 level. The other four variables from Talaga's work that were also used in this study were FEMALE, MINORITY, GPA, and MARONLY (married only, no children). Their OLS parameter estimates were 0.454, 0.027, 0.014, and 0.055, respectively. It should be remembered, however, that none of these variables were statistically significant. Keeping this in mind, these estimates may be compared with parameter estimates for MALE, WHITE, SCHOLAR, and MARRIED in the promotion model for drawdown Surface Warfare officers in the Commander Data set.

The models on SWO Captains show quite different results. No variables demonstrated statistical significance across both periods. Although being a graduate of the Naval Academy increased promotion to O-6 during the pre-drawdown by almost 14 percent, it became an insignificant factor during the drawdown. Likewise, prior enlistment decreased an officer's promotion chances by an impressive 46.5 percent in the earlier time frame, but the effect decreased in magnitude and became statistically insignificant during the drawdown. Undergraduate scholastic performance and being married without children both moved in the opposite direction. These variables went from insignificance in the pre-drawdown, to providing increased probabilities of 17 and 28 percent in the later period. The Chow test yields a rejection of the null hypothesis, so the regressions differ.

Based on the results of this analysis, promotion rates for officers in the Submarine Warfare community, as shown in Table 11, seem to be unaffected by graduate education and undergraduate academic performance, although this community exhibits the largest percentage of members with superior undergraduate

grade point averages. This high representation of the SCHOLAR variable is most likely due to the rigorous academic screening that precedes acceptance into this

	Commander Data Set		Captain Data Set	
Independent Variables	Pre-drawdown	Drawdown	Pre-drawdown	Drawdown
MALE	0.004	-0.096	**	**
WHITE	0.084	0.033	-0.477	0.046
FFGE	0.147 *	0.112 *	0.061	-0.013
SCHOLAR	0.089 *	0.015	0.031	0.171 *
HIQUAL	0.023	0.103 *	0.016	0.023
USNA	0.037	0.111 *	0.139 *	0.048
PRIENL	-0.141 *	-0.128 *	-0.465 *	-0.152
TECHMAJ	-0.018	-0.031	0.001	-0.009
MARRIED	0.075	0.079	-0.170	0.282 *
KIDS	0.130 *	0.121 *	0.084	0.192

Notes: * Significant at the 0.05 level ** Not included in model because of no variance in representation
*** coefficients represent change in probability of promotion (from OLS estimates)
LOGIT model results may be found in Appendices

TABLE 10. Comparison of Parameter Estimates (OLS) for Pre-drawdown and Drawdown Periods. Surface Warfare Officers Commander and Captain Data Sets

community. The USNA and KIDS variables are significant across periods for the Commander data set, providing roughly 15 percent increases in promotion probability. The college quality and prior enlistment variables become significant in the later years. HIQUAL increases promotion rates by 13.9 percent and PRIENL decreases the likelihood of promotion by 30 percent for this sample. The null hypothesis is rejected as a result of the Chow test, indicating different behaviors across periods.

For Submarine officers in the Captain group, only one variable exhibited statistical significance during either period. Of the officers who appeared before the

Captain promotion board between fiscal years 1990 and 1994, Naval Academy graduates were promoted at a 20 percent higher rate than those who attended other colleges. The Chow test suggests not rejecting the null hypothesis, an indication that the regressions are similar.

	Commander Data Set		Captain Data Set	
Independent Variables	Pre-drawdown	Drawdown	Pre-drawdown	Drawdown
MALE	**	**	**	**
WHITE	-0.400	-0.198	0.057	**
FFGE	-0.103	0.025	-0.053	0.069
SCHOLAR	0.013	0.006	-0.046	0.055
HIQUAL	0.041	0.139 *	-0.004	0.058
USNA	0.149 *	0.161 *	0.117	0.204 *
PRIENL	-0.174	-0.300 *	-0.172	-0.065
TECHMAJ	0.050	0.013	0.098	0.002
MARRIED	0.115	0.160	0.155	0.364
KIDS	0.144 *	0.178 *	0.060	0.443

Notes: * Significant at the 0.05 level ** Not included in model because of no variance in representation
*** coefficients represent change in probability of promotion (from OLS estimates)
**** LOGIT model results may be found in Appendices

TABLE 11. Comparison of Parameter Estimates (OLS) for Pre-drawdown and Drawdown Periods. Submarine Warfare Officers Commander and Captain Data Sets

The parameter estimate comparisons for Naval Aviators (Pilots) are provided in Table 12. For the Commander data set, four variables show significance during the pre-drawdown phase, but only one appears to be significant during the drawdown. Before the pre-drawdown promotion boards, a superior undergraduate academic record provided a 10.5 percent increase in promotion. Naval Academy graduates were promoted at a 4.7 percent rate over their peers from other schools. Being married and having children each improved promotion probabilities by approximately 15 percent. During the drawdown time frame, the WHITE variable became significant, providing a 26.4 percent increase in promotability. Chow tests

for this set of regressions failed to reject the null hypothesis, indicating like behaviors between groups.

The Captain data set for pilots was far less remarkable. Only the WHITE variable demonstrated any statistical significance, a 62.6 percent probability increase during the pre-drawdown period. All other variables remained insignificant. A Chow test performed on this set of regressions showed a failure to reject the null hypothesis.

	Commander Data Set		Captain Data Set	
Independent Variables	Pre-drawdown	Drawdown	Pre-drawdown	Drawdown
MALE	-0.241	0.201	**	-0.210
WHITE	0.109	0.264 *	0.626 *	0.016
FFGE	0.010	-0.029	-0.090	0.007
SCHOLAR	0.105 *	0.074	0.011	0.049
HIQUAL	-0.032	-0.007	0.090	0.113
USNA	0.047 *	0.043	0.062	0.008
PRIENL	-0.065	-0.030	-0.061	-0.027
TECHMAJ	-0.033	-0.027	0.035	-0.091
MARRIED	0.157 *	0.074	0.104	0.093
KIDS	0.152 *	0.038	0.101	0.129

Notes: * Significant at the 0.05 level ** Not included in model because of no variance in representation
*** coefficients represent change in probability of promotion (from OLS estimates)
**** LOGIT model results may be found in Appendices

TABLE 12. Comparison of Parameter Estimates (OLS) for Pre-drawdown and Drawdown Periods. Naval Aviators (Pilots) Commander and Captain Data Sets

Naval Flight Officers (NFO), depicted in Table 13, are also promoted, apparently, without regard for graduate education or undergraduate academic performance, as these variables are insignificant across both periods for both ranks. In the Commander data, the USNA variable is significant, during both pre-drawdown and drawdown periods, providing increased promotion probabilities of 10.9 and 13.2 percent, respectively. In the pre-drawdown period, having children

appears to improve promotability by almost 19 percent, but this variable becomes insignificant in later years. A Chow test results in rejection of the null hypothesis. The regressions behave differently.

Captain NFO's are affected to an even lesser degree by the variables in this promotion model. In the pre-drawdown period, having a technical undergraduate major decreased one's probability of promotion by nearly 40 percent, although this factor was not significant when appearing before the drawdown promotion boards. Having a superior undergraduate academic record was insignificant for pre-drawdown Captains, but showed a significant 26.8 percent increase in promotion probability in the drawdown years. The Chow test on this set suggests rejecting the null hypothesis, indicating different behaviors between models.

	Commander Data Set		Captain Data Set	
Independent Variables	Pre-drawdown	Drawdown	Pre-drawdown	Drawdown
MALE	**	0.031	**	**
WHITE	0.009	0.000	0.046	0.278
FFGE	0.066	-0.094	-0.144	-0.035
SCHOLAR	0.128	0.033	-0.086	0.239
HIQUAL	0.052	0.047	-0.109	0.268 *
USNA	0.109 *	0.132 *	0.189	0.078
PRIENL	-0.118	0.028	-0.304	-0.070
TECHMAJ	-0.030	-0.066	-0.399 *	-0.029
MARRIED	0.166	0.060	-0.081	0.143
KIDS	0.188 *	0.117	-0.003	0.310

Notes: * Significant at the 0.05 level ** Not included in model because of no variance in representation
*** coefficients represent change in probability of promotion (from OLS estimates)
**** LOGIT model results may be found in Appendices

TABLE 13. Comparison of Parameter Estimates (OLS) for Pre-drawdown and Drawdown Periods. Naval Flight Officers (NFO) Commander and Captain Data Sets

The final warfare community analyzed in this thesis, and the one most consistently benefitting from graduate education, is the community made up of Fleet

Support and Supply officers. The results of OLS regression promotion models for this group are provided in Table 14. It can be clearly seen from this table, that the FFGE variable provides a consistently significant, positive affect on promotion to the ranks of Commander and Captain for these officers. In the Commander data set, a pre-drawdown promotion probability of 22.1 percent increases to 26.4 percent during the drawdown period. Other variables that impact promotion during the pre-drawdown are WHITE, which provides a positive 13.3 percent increase, and KIDS, which contributes a 9.5 percent increase in probability. In the drawdown period, college quality improves promotion chances by 10.8 percent whereas prior enlisted service and a technical undergraduate major reduce promotion probabilities by 15.1 and 13.1 percent, respectively. The Chow test suggests rejecting the null hypothesis, an indication that the models perform differently.

For the Captain data set, the only variable that demonstrates any statistical significance is the FFGE variable. It provides an increased probability of promotion of 16 percent during the pre-drawdown period. This probability increases to 20.5 percent during the later period. The Chow test on these regressions leads to a failure to reject the null hypothesis, indicating similarity between regressions.

	Commander Data Set		Captain Data Set	
Independent Variables	Pre-drawdown	Drawdown	Pre-drawdown	Drawdown
MALE	-0.054	0.027	-0.147	-0.118
WHITE	0.133 *	-0.051	0.017	-0.138
FFGE	0.221 *	0.264 *	0.161 *	0.205 *
SCHOLAR	0.065	0.034	0.146	-0.085
HIQUAL	-0.053	0.108 *	0.115	-0.058
USNA	-0.023	0.060	-0.006	0.024
PRIENL	-0.082	-0.151 *	**	-0.047
TECHMAJ	-0.096	-0.131 *	0.152	-0.147
MARRIED	0.010	0.088	0.030	0.018
KIDS	0.095 *	0.071	0.151	0.017

Notes: * Significant at the 0.05 level ** Not included in model because of no variance in representation

*** coefficients represent change in probability of promotion (from OLS estimates)

**** LOGIT model results may be found in Appendices

TABLE 14. Comparison of Parameter Estimates (OLS) for Pre-drawdown and Drawdown Periods. Supply and Fleet Support Officers. Commander and Captain Data Sets

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

This thesis demonstrates the effects of undergraduate background and fully-funded graduate education (FFGE) on promotion to the ranks of Commander and Captain in the Navy. Based on analysis of the promotion model's parameter estimates by rank, warfare community, and time period, one can conclude that these two education variables do affect promotion, although the magnitude and significance of this effect varies according to which sub-group is being analyzed.

Both undergraduate academic performance and graduate education were significantly and positively associated with the probability of promotion, for officers' appearing before the Commander promotion boards, when using data pooled by designators and time periods. When analyzing data on separate communities, only the Surface Warfare officer community received significant effects from both variables. FFGE remained significant for the Fleet Support and Supply community and undergraduate GPA retained its significance for Pilots. When viewed from the perspective of differences between the pre-drawdown or drawdown time periods, these effects seem to change over time. SWO's had significant FFGE effects during both periods, although this effect diminished somewhat (from 14.7 to 11.2 percent) in the drawdown period. The undergraduate performance variable became statistically insignificant in the drawdown period. Fleet Support and Supply officers, on the other hand, saw an increase in the promotion rate effects from graduate education during the drawdown period, and the parameter estimates were significant during both periods.

Captains received somewhat different effects from these two education variables. Of the two, only SCHOLAR, the variable associated with an undergraduate GPA greater than 3.2, was significant for the pooled designators. A look at communities showed that undergraduate academic performance was significant for the SWO community alone, and only during the drawdown period.

FFGE returned as a significant factor for Fleet Support and Supply officers before the Captain promotion board and once again, this community demonstrated a tendency to place more emphasis on graduate education, promoting officers at a four percent greater rate during the drawdown (20.5 %), than during the pre-drawdown (16.1 %).

The simple answer to the research question presented as an introduction to this thesis is yes, there is a statistically significant difference in promotion to the ranks of Commander and Captain for U.S. Navy officers with and without graduate education. There is, however, a caveat. This difference does not seem to apply to Captain as much as it does to Commander promotions, and it does not seem to apply as much to the Submarine, Pilot, and NFO communities as much as it does to the Surface Warfare and Fleet Support and Supply communities.

These results bring to mind another question. Should graduate education have an effect on promotions? The Chief of Naval Operations indicates that it should have an effect, as quoted in his policy on graduate education (CNO, 1994). The Navy is being required to operate with a shrinking budget and manpower force, and the requirement to fill billets with people who are proven subspecialists will likely continue to grow rather than diminish.

A common theme has emerged from studies on how graduate education affects naval officer promotion. Generally, graduate education provides a positive influence on the probability for selection to the next rank. A summary of prior work from the literature review and the results of this thesis is presented in Table 15.

As this comparison shows, graduate education appears to be an important predictor of success for many designators and to many promotion points (O-4 and above).

Author	Data	Effect of Graduate Education
Cymrot (1986)	Ranks: O-3 to O-7 Communities: 3 groups (RL, Staff, URL) Analyzed as a combined group (pooled) Source: 1985 Officer Master File (OMF)	To O-4 : + 0.260 To O-5 : + 0.106 To O-6 : +0.165 To O-7 : 0.000
Jordan (1991)	Ranks: O-3 to O-5 Community: General Unrestricted Line Source: 1981-1990 OMF and Officer Promotion History Files (OPHF)	To O-4 : **+0.292** To O-5 : +0.140
Talaga (1994)	Ranks: O-3 to O-4 Community: Surface Warfare (SWO) Source: 1981-1990 OPHF and Officer Fitness Report Files	To O-4 : **+0.170**
Buterbaugh (this thesis)	Ranks: O-4 to O-6 Communities: Surface, Sub, Pilot, NFO, and Support (Supply and Fleet Support) Analyzed as pooled group and by individual community, then by time period (pre-drawdown vs. drawdown). Source: 1981-1994 OPHF	To O-5 : Pooled : **+0.087** SWO : **+0.135** SUB : -0.038 PILOT : +0.002 NFO : -0.009 SUPPORT: **+0.234** To O-6 : Pooled : -0.009 SWO : +0.023 SUB : -0.011 PILOT : -0.038 NFO : -0.072 SUPPORT: **+0.191**
Note: Bolded figures under Effect of Graduate Education are statistically significant at the 0.05 level		

Table 15. Studies on the Effect of Graduate Education on Naval Officer Promotion

B. RECOMMENDATIONS FOR FURTHER RESEARCH

This thesis has focused on the factors that affect promotion to two of the senior U.S. Navy ranks. It is, apparently, unique in its approach to evaluating promotion performance by community as well as over different time periods, one of which includes the transition to a smaller force. The data base used in this study contains similar information on all of the other officer ranks, and further research should be conducted to evaluate education effects on the different communities at lower ranks. Additionally, the promotion trends should be followed as the Navy completes its drawdown to a "right sized" force and the CNO's 1994 directive begins to take hold. If the CNO's directions are followed, fully-funded graduate education should begin to become a more important promotion factor for all communities in future years.

The issue of selectivity bias is not addressed directly in this research. Arguably, the positive promotion effects attributed to graduate education in this study's models could be attributed to the selection of officers who attend graduate school. That is to say, a higher promotion rate may not be caused by the fact that an officer has a graduate degree, but rather, that officer may have been chosen to attend graduate school because he or she was more promotable. This issue was addressed and found to be a minor one in models of promotion to the rank of LCDR (O-4) in a previous study (Talaga, 1994). Nonetheless, it deserves further investigation.

Finally, the models were limited in scope because of the available data. There are numerous factors besides those considered in this promotion model, that could affect an officer's promotability. One example would be performance during a command tour or equivalent at the rank of Commander. This factor is commonly believed to be a primary predictor of promotion to Captain and there are undoubtedly other factors that would produce similar negative effects. A study of these perceived "showstoppers" might prove an interesting follow-on to this work.

APPENDIX A. LOGIT MODEL RESULTS

TABLE A.1.A LOGIT RESULTS FOR COMMANDER DATA SET - POOLED DESIGNATORS (1981-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
POOLED DATA SET

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 9962
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	7153
2	1	2809

WARNING: 2410 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	11852.909	11533.075	.
SC	11860.115	11612.347	.
-2 LOG L	11850.909	11511.075	339.833 with 10 DF (p=0.0001)
Score	.	.	338.824 with 10 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.2859	0.1372	4.3411	0.0372	.	0.751
MALE	1	0.1976	0.0874	5.1106	0.0238	0.030131	1.219
WHITE	1	0.3632	0.1131	10.3066	0.0013	0.037425	1.438
FFGE	1	0.4677	0.0579	65.2678	0.0001	0.109047	1.596
SCHOLAR	1	0.3534	0.0661	28.5691	0.0001	0.072413	1.424
HIQUAL	1	0.1292	0.0792	2.6622	0.1028	0.020518	1.138
USNA	1	0.4606	0.0559	67.9187	0.0001	0.116612	1.585
PRIENL	1	-0.6355	0.0853	55.4532	0.0001	-0.086723	0.530
TECHMAJ	1	-0.0538	0.0543	0.9793	0.3224	-0.013273	0.948
MARRIED	1	0.4009	0.0881	20.7135	0.0001	0.082552	1.493
KIDS	1	0.5375	0.0780	47.4600	0.0001	0.130352	1.712

Association of Predicted Probabilities and Observed Responses

Concordant = 58.2%	Somers' D = 0.229
Discordant = 35.3%	Gamma = 0.245
Tied = 6.5%	Tau-a = 0.093
(20092777 pairs)	c = 0.615

TABLE A.1.B LOGIT RESULTS FOR COMMANDER DATA SET - SURFACE WARFARE OFFICERS (1981-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
SURFACE WARFARE OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 2717
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	1935
2	1	782

WARNING: 368 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	3263.410	3167.234	.
SC	3269.317	3232.214	.
-2 LOG L	3261.410	3145.234	116.176 with 10 DF (p=0.0001)
Score	.	.	113.587 with 10 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	0.2217	0.4317	0.2637	0.6076	.	1.248
MALE	1	-0.3308	0.3905	0.7178	0.3969	-0.021424	0.718
WHITE	1	0.2439	0.1945	1.5727	0.2098	0.028385	1.276
FFGE	1	0.7387	0.1092	45.7258	0.0001	0.184776	2.093
SCHOLAR	1	0.2974	0.1458	4.1590	0.0414	0.051703	1.346
HIQUAL	1	0.2846	0.1561	3.3270	0.0682	0.044710	1.329
USNA	1	0.3383	0.0988	11.7116	0.0006	0.089264	1.402
PRIENL	1	-0.6294	0.1536	16.7988	0.0001	-0.092286	0.533
TECHMAJ	1	-0.1177	0.1044	1.2701	0.2598	-0.028966	0.889
MARRIED	1	0.3600	0.1696	4.5044	0.0338	0.072859	1.433
KIDS	1	0.6089	0.1448	17.6791	0.0001	0.146080	1.838

Association of Predicted Probabilities and Observed Responses

Concordant = 59.7%	Somers' D = 0.254
Discordant = 34.2%	Gamma = 0.271
Tied = 6.1%	Tau-a = 0.104
(1513170 pairs)	c = 0.627

TABLE A.1.C LOGIT RESULTS FOR COMMANDER DATA SET - SUBMARINE OFFICERS (1981-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
SUBMARINE OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 983
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	814
2	1	169

WARNING: 240 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	904.240	852.979	.
SC	909.131	901.885	.
-2 LOG L	902.240	832.979	69.261 with 9 DF (p=0.0001)
Score	.	.	72.463 with 9 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	24.2661	0.3563	4637.4905	0.0001	.	999.000
WHITE	0	-24.2785	.	.	.	.	0.000
FFGE	1	-0.2633	0.2713	0.9423	0.3317	-0.043907	0.768
SCHOLAR	1	0.0548	0.1791	0.0935	0.7598	0.014983	1.056
HIQUAL	1	0.5405	0.2915	3.4384	0.0637	0.091707	1.717
USNA	1	1.1453	0.1925	35.3883	0.0001	0.312809	3.144
PRIENL	1	-1.0783	0.4220	6.5298	0.0106	-0.098950	0.340
TECHMAJ	1	0.1584	0.2048	0.5984	0.4392	0.038111	1.172
MARRIED	1	0.8260	0.3429	5.8023	0.0160	0.175445	2.284
KIDS	1	1.0159	0.2987	11.5658	0.0007	0.241730	2.762

Association of Predicted Probabilities and Observed Responses

Concordant = 67.6%	Somers' D = 0.398
Discordant = 27.8%	Gamma = 0.418
Tied = 4.7%	Tau-a = 0.113
(137566 pairs)	c = 0.699

TABLE A.1.D LOGIT RESULTS FOR COMMANDER DATA SET - PILOTS (1981-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
PILOTS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 3074
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	2307
2	1	767

WARNING: 488 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	3455.937	3434.495	.
SC	3461.967	3500.833	.
-2 LOG L	3453.937	3412.495	41.442 with 10 DF (p=0.0001)
Score	.	.	42.230 with 10 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.6458	0.6376	1.0258	0.3111	.	0.524
MALE	1	0.3538	0.5504	0.4133	0.5203	0.014039	1.425
WHITE	1	0.8259	0.2939	7.8974	0.0050	0.057035	2.284
FFGE	1	0.0106	0.1321	0.0064	0.9362	0.001946	1.011
SCHOLAR	1	0.5223	0.1696	9.4862	0.0021	0.081251	1.686
HIQUAL	1	-0.1296	0.1549	0.6998	0.4028	-0.019101	0.878
USNA	1	0.2446	0.0954	6.5761	0.0103	0.063296	1.277
PRIENL	1	-0.2797	0.2226	1.5785	0.2090	-0.027621	0.756
TECHMAJ	1	-0.1898	0.0972	3.8110	0.0509	-0.047142	0.827
MARRIED	1	0.6492	0.1981	10.7445	0.0010	0.123687	1.914
KIDS	1	0.5657	0.1677	11.3748	0.0007	0.123477	1.761

Association of Predicted Probabilities and Observed Responses

Concordant = 50.2%	Somers' D = 0.135
Discordant = 36.7%	Gamma = 0.155
Tied = 13.1%	Tau-a = 0.050
(1769469 pairs)	c = 0.567

TABLE A.1.E LOGIT RESULTS FOR COMMANDER DATA SET - NAVAL FLIGHT OFFICERS (1981-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
NAVAL FLIGHT OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 1029
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	688
2	1	341

WARNING: 1196 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	1309.156	1303.180	.
SC	1314.092	1357.480	.
-2 LOG L	1307.156	1281.180	25.976 with 10 DF (p=0.0038)
Score	.	.	25.802 with 10 DF (p=0.0040)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.6019	0.9315	0.4175	0.5182	.	0.548
MALE	1	0.4134	0.8385	0.2430	0.6220	0.017361	1.512
WHITE	1	0.1066	0.3863	0.0762	0.7825	0.010053	1.113
FFGE	1	-0.0391	0.1846	0.0448	0.8324	-0.008258	0.962
SCHOLAR	1	0.3344	0.2299	2.1166	0.1457	0.056772	1.397
HIQUAL	1	0.2076	0.2090	0.9867	0.3205	0.038290	1.231
USNA	1	0.5845	0.1566	13.9340	0.0002	0.151640	1.794
PRIENL	1	-0.2576	0.3513	0.5377	0.4634	-0.026455	0.773
TECHMAJ	1	-0.2087	0.1611	1.6789	0.1951	-0.051235	0.812
MARRIED	1	0.4765	0.3021	2.4878	0.1147	0.094505	1.610
KIDS	1	0.7068	0.2636	7.1895	0.0073	0.160631	2.028

Association of Predicted Probabilities and Observed Responses

Concordant = 53.7%	Somers' D = 0.182
Discordant = 35.5%	Gamma = 0.204
Tied = 10.7%	Tau-a = 0.081
(234608 pairs)	c = 0.591

TABLE A.1.F LOGIT RESULTS FOR COMMANDER DATA SET - FLEET SUPPORT AND SUPPLY OFFICERS (1981-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
FLEET SUPPORT AND SUPPLY OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 2159
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	1409
2	1	750

WARNING: 118 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	2790.614	2630.477	.
SC	2796.292	2692.928	.
-2 LOG L	2788.614	2608.477	180.138 with 10 DF (p=0.0001)
Score	.	.	172.505 with 10 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.1236	0.2050	0.3634	0.5466	.	0.884
MALE	1	-0.0209	0.1223	0.0292	0.8643	-0.005525	0.979
WHITE	1	0.1909	0.1848	1.0670	0.3016	0.026185	1.210
FFGE	1	1.1335	0.1048	116.9835	0.0001	0.305947	3.106
SCHOLAR	1	0.2115	0.1153	3.3662	0.0665	0.050449	1.236
HIQUAL	1	0.1018	0.1645	0.3828	0.5361	0.016016	1.107
USNA	1	0.0679	0.2071	0.1075	0.7430	0.009192	1.070
PRIENL	1	-0.6142	0.1400	19.2497	0.0001	-0.113443	0.541
TECHMAJ	1	-0.5424	0.1901	8.1390	0.0043	-0.072424	0.581
MARRIED	1	0.1947	0.1484	1.7221	0.1894	0.044378	1.215
KIDS	1	0.3454	0.1447	5.6999	0.0170	0.093248	1.413

Association of Predicted Probabilities and Observed Responses

Concordant = 65.0%	Somers' D = 0.339
Discordant = 31.1%	Gamma = 0.353
Tied = 4.0%	Tau-a = 0.154
(1056750 pairs)	c = 0.669

TABLE A.2.A LOGIT RESULTS FOR CAPTAIN DATA SET - POOLED DESIGNATORS (1981-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
POOLED DATA SET

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 3972
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	2131
2	1	1841

WARNING: 644 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	5487.169	5444.503	.
SC	5493.456	5513.660	.
-2 LOG L	5485.169	5422.503	62.666 with 10 DF (p=0.0001)
Score	.	.	62.131 with 10 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.2547	0.3013	0.7147	0.3979	.	0.775
MALE	1	-0.1045	0.1876	0.3104	0.5774	-0.011262	0.901
WHITE	1	-0.0754	0.2536	0.0884	0.7662	-0.005275	0.927
FFGE	1	-0.0375	0.0764	0.2405	0.6238	-0.008868	0.963
SCHOLAR	1	0.3007	0.0976	9.4986	0.0021	0.056777	1.351
HIQUAL	1	0.2091	0.1129	3.4329	0.0639	0.033878	1.233
USNA	1	0.3746	0.0724	26.7424	0.0001	0.097392	1.454
PRIENL	1	-0.4732	0.1917	6.0941	0.0136	-0.044484	0.623
TECHMAJ	1	0.0155	0.0806	0.0369	0.8477	0.003549	1.016
MARRIED	1	0.2656	0.1855	2.0501	0.1522	0.042406	1.304
KIDS	1	0.4509	0.1663	7.3567	0.0067	0.086465	1.570

Association of Predicted Probabilities and Observed Responses

Concordant = 51.5%	Somers' D = 0.139
Discordant = 37.7%	Gamma = 0.155
Tied = 10.8%	Tau-a = 0.069
(3923171 pairs)	c = 0.569

TABLE A.2.B LOGIT RESULTS FOR CAPTAIN DATA SET - SURFACE WARFARE OFFICERS (1981-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
SURFACE WARFARE OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 1127
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	619
2	1	508

WARNING: 75 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	1553.403	1544.027	.
SC	1558.431	1594.300	.
-2 LOG L	1551.403	1524.027	27.376 with 9 DF (p=0.0012)
Score	.	.	26.891 with 9 DF (p=0.0015)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.0960	0.5951	0.0260	0.8718	.	0.908
MALE	0	0	.	.	.	.	.
WHITE	1	-0.4146	0.5243	0.6252	0.4291	-0.027053	0.661
FFGE	1	0.0944	0.1404	0.4524	0.5012	0.024594	1.099
SCHOLAR	1	0.5170	0.2251	5.2751	0.0216	0.081091	1.677
HIQUAL	1	0.1071	0.2099	0.2602	0.6100	0.017876	1.113
USNA	1	0.3547	0.1324	7.1737	0.0074	0.095287	1.426
PRIENL	1	-1.0092	0.4089	6.0913	0.0136	-0.089605	0.365
TECHMAJ	1	-0.0360	0.1566	0.0528	0.8183	-0.008315	0.965
MARRIED	1	0.3390	0.3559	0.9073	0.3408	0.049910	1.404
KIDS	1	0.5579	0.2902	3.6962	0.0545	0.101490	1.747

Association of Predicted Probabilities and Observed Responses

Concordant = 53.4%	Somers' D = 0.174
Discordant = 36.0%	Gamma = 0.195
Tied = 10.6%	Tau-a = 0.086
(314452 pairs)	c = 0.587

TABLE A.2.C LOGIT RESULTS FOR CAPTAIN DATA SET - SUBMARINE OFFICERS (1981-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
SUBMARINE OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 478
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	335
2	1	143

WARNING: 59 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	585.307	591.959	.
SC	589.476	633.655	.
-2 LOG L	583.307	571.959	11.347 with 9 DF (p=0.2526)
Score	.	.	11.745 with 9 DF (p=0.2281)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.6387	1.3772	0.2151	0.6428	.	0.528
WHITE	1	0.2985	1.2351	0.0584	0.8090	0.013010	1.348
FFGE	1	-0.0525	0.3980	0.0174	0.8950	-0.007350	0.949
SCHOLAR	1	-0.0163	0.2139	0.0058	0.9391	-0.004448	0.984
HIQUAL	1	0.1247	0.3651	0.1168	0.7326	0.021070	1.133
USNA	1	0.6496	0.2580	6.3399	0.0118	0.167264	1.915
PRIENL	1	-0.6047	0.7430	0.6624	0.4157	-0.042815	0.546
TECHMAJ	1	0.2225	0.2174	1.0468	0.3063	0.061337	1.249
MARRIED	1	0.5969	0.6829	0.7638	0.3821	0.092245	1.816
KIDS	1	0.6877	0.6017	1.3061	0.2531	0.119169	1.989

Association of Predicted Probabilities and Observed Responses

Concordant = 54.5%	Somers' D = 0.180
Discordant = 36.5%	Gamma = 0.198
Tied = 9.0%	Tau-a = 0.076
(47905 pairs)	c = 0.590

TABLE A.2.D LOGIT RESULTS FOR CAPTAIN DATA SET - PILOTS (1981-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
PILOTS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 1374
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	751
2	1	623

WARNING: 144 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	1894.827	1903.793	.
SC	1900.052	1961.273	.
-2 LOG L	1892.827	1881.793	11.034 with 10 DF (p=0.3549)
Score	.	.	10.922 with 10 DF (p=0.3637)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.0980	1.3549	0.0052	0.9424	.	0.907
MALE	1	-0.8598	1.1660	0.5438	0.4609	-0.025549	0.423
WHITE	1	0.6749	0.5757	1.3745	0.2410	0.036037	1.964
FFGE	1	-0.1518	0.1652	0.8445	0.3581	-0.029034	0.859
SCHOLAR	1	0.1201	0.2172	0.3057	0.5803	0.016884	1.128
HIQUAL	1	0.4118	0.2155	3.6505	0.0561	0.060340	1.510
USNA	1	0.0878	0.1238	0.5034	0.4780	0.021955	1.092
PRIENL	1	-0.1931	0.3089	0.3908	0.5319	-0.018753	0.824
TECHMAJ	1	-0.1485	0.1442	1.0607	0.3031	-0.032446	0.862
MARRIED	1	0.3975	0.4125	0.9288	0.3352	0.062360	1.488
KIDS	1	0.4846	0.3743	1.6762	0.1954	0.083829	1.623

Association of Predicted Probabilities and Observed Responses

Concordant = 43.6%	Somers' D = 0.084
Discordant = 35.2%	Gamma = 0.107
Tied = 21.1%	Tau-a = 0.042
(467873 pairs)	c = 0.542

TABLE A.2.E LOGIT RESULTS FOR CAPTAIN DATA SET - NAVAL FLIGHT OFFICERS (1981-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
NAVAL FLIGHT OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 325
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	133
2	1	192

WARNING: 352 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	441.775	439.982	.
SC	445.559	477.820	.
-2 LOG L	439.775	419.982	19.794 with 9 DF (p=0.0192)
Score	.	.	18.599 with 9 DF (p=0.0288)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-1.9095	1.5667	1.4855	0.2229	.	0.148
MALE	0	0	.	.	.	.	.
WHITE	1	0.5799	1.2059	0.2313	0.6306	0.035305	1.786
FFGE	1	-0.3231	0.3318	0.9484	0.3301	-0.070955	0.724
SCHOLAR	1	0.4560	0.4346	1.1013	0.2940	0.069502	1.578
HIQUAL	1	0.3438	0.3600	0.9122	0.3395	0.063032	1.410
USNA	1	0.3564	0.2739	1.6931	0.1932	0.089771	1.428
PRIENL	1	-1.1212	0.8158	1.8889	0.1693	-0.106914	0.326
TECHMAJ	1	-0.8521	0.3320	6.5868	0.0103	-0.196367	0.427
MARRIED	1	0.4452	1.1838	0.1414	0.7068	0.068981	1.561
KIDS	1	1.1191	1.1058	1.0241	0.3115	0.191549	3.062

Association of Predicted Probabilities and Observed Responses

Concordant = 55.7%	Somers' D = 0.271
Discordant = 28.6%	Gamma = 0.321
Tied = 15.7%	Tau-a = 0.131
(25536 pairs)	c = 0.635

TABLE A.2.F LOGIT RESULTS FOR CAPTAIN DATA SET - FLEET SUPPORT AND SUPPLY OFFICERS (1981-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
FLEET SUPPORT AND SUPPLY OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 668
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	293
2	1	375

WARNING: 14 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	917.953	911.568	.
SC	922.458	961.115	.
-2 LOG L	915.953	889.568	26.385 with 10 DF (p=0.0033)
Score	.	.	26.107 with 10 DF (p=0.0036)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	0.1892	0.4285	0.1950	0.6588	.	1.208
MALE	1	-0.5198	0.2821	3.3946	0.0654	-0.120797	0.595
WHITE	1	-0.5520	0.3952	1.9508	0.1625	-0.062068	0.576
FFGE	1	0.7926	0.1673	22.4432	0.0001	0.217447	2.209
SCHOLAR	1	-0.0687	0.2170	0.1002	0.7516	-0.014356	0.934
HIQUAL	1	0.0771	0.2682	0.0827	0.7736	0.012869	1.080
USNA	1	0.0242	0.2658	0.0083	0.9275	0.004111	1.024
PRIENL	1	-0.0851	0.4117	0.0427	0.8363	-0.009244	0.918
TECHMAJ	1	-0.2103	0.3481	0.3650	0.5457	-0.026878	0.810
MARRIED	1	0.0667	0.3123	0.0456	0.8309	0.012505	1.069
KIDS	1	0.1863	0.3161	0.3473	0.5557	0.045521	1.205

Association of Predicted Probabilities and Observed Responses

Concordant = 56.5%	Somers' D = 0.217
Discordant = 34.8%	Gamma = 0.238
Tied = 8.7%	Tau-a = 0.107
(109875 pairs)	c = 0.609

TABLE A.3.A LOGIT RESULTS FOR COMMANDER DATA SET - POOLED DESIGNATORS
PRE-DRAWDOWN (1981-1989)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
POOLED DATA SET

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 6220
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	4596
2	1	1624

WARNING: 1664 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	7145.015	6954.826	.
SC	7151.750	7028.917	.
-2 LOG L	7143.015	6932.826	210.188 with 10 DF (p=0.0001)
Score	.	.	207.165 with 10 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.3226	0.2001	2.5998	0.1069	.	0.724
MALE	1	0.0684	0.1283	0.2843	0.5939	0.009243	1.071
WHITE	1	0.5490	0.1659	10.9585	0.0009	0.048214	1.732
FFGE	1	0.4783	0.0773	38.3100	0.0001	0.110006	1.613
SCHOLAR	1	0.5769	0.1010	32.6270	0.0001	0.107000	1.781
HIQUAL	1	-0.0302	0.1063	0.0808	0.7763	-0.004496	0.970
USNA	1	0.3783	0.0711	28.2879	0.0001	0.096474	1.460
PRIENL	1	-0.5706	0.1203	22.4872	0.0001	-0.070824	0.565
TECHMAJ	1	0.00628	0.0732	0.0074	0.9316	0.001502	1.006
MARRIED	1	0.4201	0.1183	12.6097	0.0004	0.084502	1.522
KIDS	1	0.6251	0.1055	35.1361	0.0001	0.148067	1.868

Association of Predicted Probabilities and Observed Responses

Concordant = 57.1%	Somers' D = 0.228
Discordant = 34.3%	Gamma = 0.249
Tied = 8.6%	Tau-a = 0.088
(7463904 pairs)	c = 0.614

TABLE A.3.B LOGIT RESULTS FOR COMMANDER DATA SET - SURFACE WARFARE OFFICERS
PRE-DRAWDOWN (1981-1989)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
SURFACE WARFARE OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 1699
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	1233
2	1	466

WARNING: 237 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	1998.218	1942.175	.
SC	2003.656	2001.991	.
-2 LOG L	1996.218	1920.175	76.043 with 10 DF (p=0.0001)
Score	.	.	73.639 with 10 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.2790	1.2334	0.0512	0.8211	.	0.757
MALE	1	0.0688	1.1937	0.0033	0.9540	0.001840	1.071
WHITE	1	0.3854	0.3054	1.5921	0.2070	0.035572	1.470
FFGE	1	0.8363	0.1410	35.2025	0.0001	0.212101	2.308
SCHOLAR	1	0.5051	0.2076	5.9186	0.0150	0.082268	1.657
HIQUAL	1	0.1242	0.2069	0.3603	0.5484	0.018335	1.132
USNA	1	0.2004	0.1231	2.6513	0.1035	0.053845	1.222
PRIENL	1	-0.6531	0.2122	9.4701	0.0021	-0.087876	0.520
TECHMAJ	1	-0.0946	0.1395	0.4599	0.4977	-0.022662	0.910
MARRIED	1	0.3517	0.2259	2.4244	0.1195	0.069601	1.421
KIDS	1	0.6345	0.1922	10.8935	0.0010	0.148192	1.886

Association of Predicted Probabilities and Observed Responses

Concordant = 59.1%	Somers' D = 0.258
Discordant = 33.4%	Gamma = 0.278
Tied = 7.5%	Tau-a = 0.103
(574578 pairs)	c = 0.629

TABLE A.3.C LOGIT RESULTS FOR COMMANDER DATA SET - SUBMARINE OFFICERS
PRE-DRAWDOWN (1981-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
SUBMARINE OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 520
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	453
2	1	67

WARNING: 179 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	401.555	377.040	.
SC	405.809	419.578	.
-2 LOG L	399.555	357.040	42.515 with 9 DF (p=0.0001)
Score	.	.	45.996 with 9 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	23.7039	0.5515	1847.5553	0.0001	.	999.000
WHITE	0	-23.7238	.	.	.	.	0.000
FFGE	1	-0.6990	0.4237	2.7212	0.0990	-0.100392	0.497
SCHOLAR	1	0.1562	0.2948	0.2806	0.5963	0.042501	1.169
HIQUAL	1	0.2331	0.4548	0.2626	0.6083	0.036160	1.262
USNA	1	1.3499	0.3123	18.6885	0.0001	0.362758	3.857
PRIENL	1	-0.8296	0.5853	2.0086	0.1564	-0.079059	0.436
TECHMAJ	1	0.5219	0.3022	2.9819	0.0842	0.131734	1.685
MARRIED	1	0.7951	0.5304	2.2471	0.1339	0.169553	2.215
KIDS	1	1.1014	0.4738	5.4033	0.0201	0.259729	3.008

Association of Predicted Probabilities and Observed Responses

Concordant = 71.6%	Somers' D = 0.473
Discordant = 24.2%	Gamma = 0.494
Tied = 4.2%	Tau-a = 0.106
(30351 pairs)	c = 0.737

TABLE A.3.D LOGIT RESULTS FOR COMMANDER DATA SET - PILOTS
PRE-DRAWDOWN (1981-1989)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
PILOTS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 2222
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	1683
2	1	539

WARNING: 347 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	2464.105	2447.714	.
SC	2469.811	2510.482	.
-2 LOG L	2462.105	2425.714	36.391 with 10 DF (p=0.0001)
Score	.	.	35.219 with 10 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	22.2979	0.4474	2483.9121	0.0001	.	999.000
MALE	0	-22.4295	.	.	.	.	0.000
WHITE	1	0.5214	0.4002	1.6968	0.1927	0.032070	1.684
FFGE	1	0.0556	0.1583	0.1236	0.7251	0.010337	1.057
SCHOLAR	1	0.6989	0.2505	7.7842	0.0053	0.093951	2.011
HIQUAL	1	-0.1614	0.1934	0.6961	0.4041	-0.022258	0.851
USNA	1	0.2700	0.1166	5.3626	0.0206	0.068220	1.310
PRIENL	1	-0.3291	0.2552	1.6631	0.1972	-0.033190	0.720
TECHMAJ	1	-0.1806	0.1208	2.2350	0.1349	-0.042835	0.835
MARRIED	1	0.7743	0.2407	10.3482	0.0013	0.145292	2.169
KIDS	1	0.7408	0.2041	13.1754	0.0003	0.158459	2.098

Association of Predicted Probabilities and Observed Responses

Concordant = 49.9%	Somers' D = 0.154
Discordant = 34.5%	Gamma = 0.182
Tied = 15.6%	Tau-a = 0.057
(907137 pairs)	c = 0.577

TABLE A.3.E LOGIT RESULTS FOR COMMANDER DATA SET - NAVAL FLIGHT OFFICERS
PRE-DRAWDOWN (1981-1989)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
NAVAL FLIGHT OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 561
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	406
2	1	155

WARNING: 833 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	663.326	661.534	.
SC	667.656	704.831	.
-2 LOG L	661.326	641.534	19.792 with 9 DF (p=0.0192)
Score	.	.	19.296 with 9 DF (p=0.0228)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.1259	0.6796	0.0343	0.8531	.	0.882
MALE	0	0	.	.	.	.	.
WHITE	1	0.0278	0.5735	0.0024	0.9613	0.002475	1.028
FFGE	1	0.3663	0.2895	1.6012	0.2057	0.076754	1.442
SCHOLAR	1	0.8051	0.4272	3.5517	0.0595	0.124276	2.237
HIQUAL	1	0.2607	0.3062	0.7251	0.3945	0.046658	1.298
USNA	1	0.5857	0.2246	6.7997	0.0091	0.153341	1.796
PRIENL	1	-0.5157	0.4424	1.3590	0.2437	-0.057590	0.597
TECHMAJ	1	-0.1545	0.2428	0.4050	0.5245	-0.037251	0.857
MARRIED	1	0.7378	0.4617	2.5531	0.1101	0.139331	2.091
KIDS	1	0.8625	0.3963	4.7381	0.0295	0.185647	2.369

Association of Predicted Probabilities and Observed Responses

Concordant = 56.3%	Somers' D = 0.242
Discordant = 32.1%	Gamma = 0.273
Tied = 11.6%	Tau-a = 0.097
(62930 pairs)	c = 0.621

TABLE A.3.F LOGIT RESULTS FOR COMMANDER DATA SET - FLEET SUPPORT AND SUPPLY OFFICERS PRE-DRAWDOWN (1981-1989)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
FLEET SUPPORT AND SUPPLY OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 1218
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	821
2	1	397

WARNING: 68 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	1539.771	1462.751	.
SC	1544.876	1518.906	.
-2 LOG L	1537.771	1440.751	97.020 with 10 DF (p=0.0001)
Score	.	.	92.221 with 10 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.2621	0.2891	0.8219	0.3646	.	0.769
MALE	1	-0.2511	0.1810	1.9241	0.1654	-0.064604	0.778
WHITE	1	0.5880	0.2640	4.9600	0.0259	0.074971	1.800
FFGE	1	1.1249	0.1461	59.3068	0.0001	0.299885	3.080
SCHOLAR	1	0.3489	0.1749	3.9806	0.0460	0.076427	1.418
HIQUAL	1	-0.2404	0.2264	1.1275	0.2883	-0.036235	0.786
USNA	1	-0.1239	0.2505	0.2445	0.6209	-0.018236	0.883
PRIENL	1	-0.3873	0.2232	3.0121	0.0826	-0.060732	0.679
TECHMAJ	1	-0.4558	0.2523	3.2656	0.0707	-0.062284	0.634
MARRIED	1	0.0413	0.2016	0.0419	0.8377	0.009293	1.042
KIDS	1	0.4561	0.2063	4.8907	0.0270	0.122984	1.578

Association of Predicted Probabilities and Observed Responses

Concordant = 64.9%	Somers' D = 0.348
Discordant = 30.1%	Gamma = 0.367
Tied = 5.0%	Tau-a = 0.153
(325937 pairs)	c = 0.674

TABLE A.4.A LOGIT RESULTS FOR CAPTAIN DATA SET - POOLED DESIGNATORS
PRE-DRAWDOWN (1981-1989)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
POOLED DATA SET

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 1913
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	1051
2	1	862

WARNING: 207 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	2635.278	2611.179	.
SC	2640.834	2672.300	.
-2 LOG L	2633.278	2589.179	44.099 with 10 DF (p=0.0001)
Score	.	.	43.538 with 10 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.4330	0.6179	0.4912	0.4834	.	0.649
MALE	1	0.0744	0.3792	0.0385	0.8445	0.005497	1.077
WHITE	1	0.0623	0.5279	0.0139	0.9060	0.003031	1.064
FFGE	1	-0.1582	0.1182	1.7913	0.1808	-0.035745	0.854
SCHOLAR	1	0.1894	0.1485	1.6261	0.2022	0.034405	1.208
HIQUAL	1	0.1482	0.1584	0.8751	0.3496	0.024667	1.160
USNA	1	0.5191	0.1073	23.3963	0.0001	0.132337	1.681
PRIENL	1	-0.5976	0.2821	4.4876	0.0341	-0.055069	0.550
TECHMAJ	1	0.1910	0.1253	2.3237	0.1274	0.040902	1.210
MARRIED	1	0.0482	0.2953	0.0267	0.8703	0.006741	1.049
KIDS	1	0.3534	0.2521	1.9655	0.1609	0.060930	1.424

Association of Predicted Probabilities and Observed Responses

Concordant = 51.1%	Somers' D = 0.167
Discordant = 34.4%	Gamma = 0.195
Tied = 14.5%	Tau-a = 0.083
(905962 pairs)	c = 0.584

TABLE A.4.B LOGIT RESULTS FOR CAPTAIN DATA SET - SURFACE WARFARE OFFICERS
PRE-DRAWDOWN (1981-1989)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
SURFACE WARFARE OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 513
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	281
2	1	232

WARNING: 36 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	708.482	689.834	.
SC	712.722	732.237	.
-2 LOG L	706.482	669.834	36.648 with 9 DF (p=0.0001)
Score	.	.	33.373 with 9 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	24.7760	0.4016	3805.7786	0.0001	.	999.000
MALE	0	0	.	.	.	.	.
WHITE	0	-25.1307	.	.	.	.	0.000
FFGE	1	0.2704	0.2301	1.3810	0.2399	0.068273	1.311
SCHOLAR	1	0.1312	0.3845	0.1164	0.7330	0.017760	1.140
HIQUAL	1	0.0763	0.2883	0.0700	0.7914	0.013719	1.079
USNA	1	0.5996	0.2122	7.9860	0.0047	0.154801	1.821
PRIENL	1	-2.5582	1.0722	5.6925	0.0170	-0.195177	0.077
TECHMAJ	1	0.00382	0.2685	0.0002	0.9887	0.000812	1.004
MARRIED	1	-0.7012	0.5343	1.7221	0.1894	-0.097570	0.496
KIDS	1	0.3769	0.3999	0.8883	0.3459	0.068729	1.458

Association of Predicted Probabilities and Observed Responses

Concordant = 54.9%	Somers' D = 0.242
Discordant = 30.8%	Gamma = 0.282
Tied = 14.3%	Tau-a = 0.120
(65192 pairs)	c = 0.621

TABLE A.4.C LOGIT RESULTS FOR CAPTAIN DATA SET - SUBMARINE OFFICERS
PRE-DRAWDOWN (1981-1989)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
SUBMARINE OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 269
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	192
2	1	77

WARNING: 23 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	324.130	336.242	.
SC	327.725	372.189	.
-2 LOG L	322.130	316.242	5.889 with 9 DF (p=0.7510)
Score	.	.	5.946 with 9 DF (p=0.7453)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.0734	1.4593	0.0025	0.9599	.	0.929
WHITE	1	0.2779	1.2406	0.0502	0.8228	0.016117	1.320
FFGE	1	-0.2511	0.5015	0.2507	0.6166	-0.037211	0.778
SCHOLAR	1	-0.2260	0.2956	0.5843	0.4446	-0.060675	0.798
HIQUAL	1	-0.0291	0.4976	0.0034	0.9534	-0.005195	0.971
USNA	1	0.5729	0.3926	2.1291	0.1445	0.147116	1.773
PRIENL	1	-0.7205	0.8650	0.6938	0.4049	-0.058769	0.487
TECHMAJ	1	0.4940	0.3497	1.9957	0.1577	0.130092	1.639
MARRIED	1	0.8112	0.9918	0.6691	0.4134	0.105983	2.251
KIDS	1	0.2708	0.7720	0.1230	0.7258	0.042640	1.311

Association of Predicted Probabilities and Observed Responses

Concordant = 51.2%	Somers' D = 0.148
Discordant = 36.3%	Gamma = 0.170
Tied = 12.5%	Tau-a = 0.061
(14784 pairs)	c = 0.574

TABLE A.4.D LOGIT RESULTS FOR CAPTAIN DATA SET - PILOTS
PRE-DRAWDOWN (1981-1989)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
PILOTS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 727
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	408
2	1	319

WARNING: 32 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	998.913	1005.401	.
SC	1003.502	1051.290	.
-2 LOG L	996.913	985.401	11.512 with 9 DF (p=0.2422)
Score	.	.	10.355 with 9 DF (p=0.3225)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-24.9525	0.5653	1948.3485	0.0001	.	0.000
MALE	0	0	.	.	.	.	.
WHITE	0	24.7542	.	.	.	.	999.000
FFGE	1	-0.3675	0.2284	2.5887	0.1076	-0.071264	0.692
SCHOLAR	1	0.0452	0.2805	0.0259	0.8721	0.006804	1.046
HIQUAL	1	0.3821	0.3090	1.5293	0.2162	0.054327	1.465
USNA	1	0.2546	0.1808	1.9821	0.1592	0.060741	1.290
PRIENL	1	-0.2485	0.3557	0.4880	0.4848	-0.028947	0.780
TECHMAJ	1	0.1429	0.2101	0.4629	0.4963	0.030126	1.154
MARRIED	1	0.4227	0.6279	0.4531	0.5009	0.059559	1.526
KIDS	1	0.4083	0.5655	0.5214	0.4703	0.063830	1.504

Association of Predicted Probabilities and Observed Responses

Concordant = 45.4%	Somers' D = 0.127
Discordant = 32.6%	Gamma = 0.163
Tied = 22.0%	Tau-a = 0.063
(130152 pairs)	c = 0.564

TABLE A.4.E LOGIT RESULTS FOR CAPTAIN DATA SET - NAVAL FLIGHT OFFICERS
PRE-DRAWDOWN (1981-1989)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
NAVAL FLIGHT OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 150
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	68
2	1	82

WARNING: 110 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	208.636	201.583	.
SC	211.646	231.689	.
-2 LOG L	206.636	181.583	25.053 with 9 DF (p=0.0029)
Score	.	.	22.005 with 9 DF (p=0.0089)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	0.0276	1.9739	0.0002	0.9888	.	1.028
MALE	0	0	.	.	.	.	.
WHITE	1	0.1865	1.4334	0.0169	0.8965	0.011833	1.205
FFGE	1	-0.7915	0.6033	1.7207	0.1896	-0.160505	0.453
SCHOLAR	1	-0.3972	0.8283	0.2299	0.6316	-0.059610	0.672
HIQUAL	1	-0.4430	0.5226	0.7186	0.3966	-0.083300	0.642
USNA	1	0.9711	0.5230	3.4471	0.0634	0.214874	2.641
PRIENL	1	-1.3890	1.1711	1.4068	0.2356	-0.137930	0.249
TECHMAJ	1	-2.1661	0.7105	9.2954	0.0023	-0.453574	0.115
MARRIED	1	-0.4318	1.5447	0.0782	0.7798	-0.062274	0.649
KIDS	1	-0.0276	1.3771	0.0004	0.9840	-0.004443	0.973

Association of Predicted Probabilities and Observed Responses

Concordant = 60.8%	Somers' D = 0.426
Discordant = 18.2%	Gamma = 0.539
Tied = 20.9%	Tau-a = 0.213
(5576 pairs)	c = 0.713

TABLE A.4.F LOGIT RESULTS FOR CAPTAIN DATA SET - FLEET SUPPORT AND SUPPLY OFFICERS PRE-DRAWDOWN (1981-1989)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
FLEET SUPPORT AND SUPPLY OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 254
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	102
2	1	152

WARNING: 6 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	344.212	349.403	.
SC	347.749	384.776	.
-2 LOG L	342.212	329.403	12.809 with 9 DF (p=0.1714)
Score	.	.	12.742 with 9 DF (p=0.1746)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.9352	1.2834	0.5310	0.4662	.	0.393
MALE	1	-0.6429	0.6291	1.0445	0.3068	-0.122417	0.526
WHITE	1	0.0801	1.2845	0.0039	0.9503	0.004778	1.083
FFGE	1	0.6841	0.2774	6.0829	0.0136	0.186106	1.982
SCHOLAR	1	0.6129	0.4192	2.1373	0.1438	0.109275	1.846
HIQUAL	1	0.4964	0.4269	1.3520	0.2449	0.085876	1.643
USNA	1	-0.0231	0.4195	0.0030	0.9561	-0.004172	0.977
PRIENL	0	0	.	.	.	.	.
TECHMAJ	1	0.6448	0.6211	1.0776	0.2992	0.075568	1.906
MARRIED	1	0.1457	0.6572	0.0492	0.8245	0.021178	1.157
KIDS	1	0.6625	0.6471	1.0482	0.3059	0.138507	1.940

Association of Predicted Probabilities and Observed Responses

Concordant = 54.4%	Somers' D = 0.242
Discordant = 30.2%	Gamma = 0.286
Tied = 15.4%	Tau-a = 0.117
(15504 pairs)	c = 0.621

TABLE A.5.A LOGIT RESULTS FOR COMMANDER DATA SET - POOLED DESIGNATORS
DRAWDOWN PERIOD (1990-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
POOLED DATA SET

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 3742
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	2557
2	1	1185

WARNING: 746 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	4674.547	4546.118	.
SC	4680.774	4614.619	.
-2 LOG L	4672.547	4524.118	148.429 with 10 DF (p=0.0001)
Score	.	.	147.342 with 10 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.2270	0.1915	1.4054	0.2358	.	0.797
MALE	1	0.2496	0.1207	4.2740	0.0387	0.043987	1.284
WHITE	1	0.1355	0.1560	0.7552	0.3848	0.016769	1.145
FFGE	1	0.4873	0.0886	30.2519	0.0001	0.116028	1.628
SCHOLAR	1	0.2447	0.0902	7.3536	0.0067	0.056304	1.277
HIQUAL	1	0.3888	0.1195	10.5782	0.0011	0.067454	1.475
USNA	1	0.5801	0.0913	40.4142	0.0001	0.144982	1.786
PRIENL	1	-0.6110	0.1234	24.4948	0.0001	-0.094212	0.543
TECHMAJ	1	-0.0872	0.0827	1.1124	0.2916	-0.022453	0.916
MARRIED	1	0.3883	0.1332	8.4947	0.0036	0.082836	1.474
KIDS	1	0.4272	0.1170	13.3296	0.0003	0.107139	1.533

Association of Predicted Probabilities and Observed Responses

Concordant = 59.7%	Somers' D = 0.237
Discordant = 36.0%	Gamma = 0.248
Tied = 4.3%	Tau-a = 0.103
(3030045 pairs)	c = 0.618

TABLE A.5.B LOGIT RESULTS FOR COMMANDER DATA SET - SURFACE WARFARE OFFICERS DRAWDOWN PERIOD (1990-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
SURFACE WARFARE OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 1018
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	702
2	1	316

WARNING: 131 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	1263.160	1237.933	.
SC	1268.086	1292.115	.
-2 LOG L	1261.160	1215.933	45.227 with 10 DF (p=0.0001)
Score	.	.	44.375 with 10 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	0.3978	0.4861	0.6698	0.4131	.	1.489
MALE	1	-0.4688	0.4273	1.2037	0.2726	-0.046465	0.626
WHITE	1	0.1590	0.2570	0.3827	0.5362	0.023327	1.172
FFGE	1	0.5832	0.1752	11.0814	0.0009	0.142175	1.792
SCHOLAR	1	0.0803	0.2087	0.1480	0.7005	0.015253	1.084
HIQUAL	1	0.5034	0.2399	4.4016	0.0359	0.086196	1.654
USNA	1	0.5653	0.1700	11.0536	0.0009	0.143101	1.760
PRIENL	1	-0.5538	0.2251	6.0532	0.0139	-0.090912	0.575
TECHMAJ	1	-0.1569	0.1607	0.9535	0.3288	-0.040087	0.855
MARRIED	1	0.3548	0.2592	1.8741	0.1710	0.074343	1.426
KIDS	1	0.5566	0.2228	6.2414	0.0125	0.138719	1.745

Association of Predicted Probabilities and Observed Responses

Concordant = 60.6%	Somers' D = 0.262
Discordant = 34.4%	Gamma = 0.276
Tied = 5.0%	Tau-a = 0.112
(221832 pairs)	c = 0.631

TABLE A.5.C LOGIT RESULTS FOR COMMANDER DATA SET - SUBMARINE OFFICERS
DRAWDOWN PERIOD (1990-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
SUBMARINE OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 463
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	361
2	1	102

WARNING: 61 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	490.271	475.815	.
SC	494.409	517.192	.
-2 LOG L	488.271	455.815	32.456 with 9 DF (p=0.0002)
Score	.	.	32.594 with 9 DF (p=0.0002)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	25.0410	0.4815	2704.5658	0.0001	.	999.000
WHITE	0	-25.2162	.	.	.	.	0.000
FFGE	1	0.1518	0.3634	0.1745	0.6761	0.028534	1.164
SCHOLAR	1	0.0301	0.2347	0.0164	0.8980	0.008274	1.031
HIQUAL	1	0.7664	0.3832	4.0004	0.0455	0.141047	2.152
USNA	1	0.9293	0.2507	13.7366	0.0002	0.256229	2.533
PRIENL	1	-1.3171	0.6304	4.3650	0.0367	-0.115503	0.268
TECHMAJ	1	0.0600	0.2964	0.0409	0.8397	0.013417	1.062
MARRIED	1	0.8511	0.4592	3.4354	0.0638	0.180191	2.342
KIDS	1	0.9565	0.3928	5.9283	0.0149	0.230058	2.603

Association of Predicted Probabilities and Observed Responses

Concordant	= 64.6%	Somers' D	= 0.347
Discordant	= 29.9%	Gamma	= 0.368
Tied	= 5.5%	Tau-a	= 0.120
(36822 pairs)		c	= 0.674

TABLE A.5.D LOGIT RESULTS FOR COMMANDER DATA SET - PILOTS
DRAWDOWN PERIOD (1990-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
PILOTS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 852
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	624
2	1	228

WARNING: 141 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	991.790	996.682	.
SC	996.538	1048.906	.
-2 LOG L	989.790	974.682	15.108 with 10 DF (p=0.1282)
Score	.	.	15.965 with 10 DF (p=0.1006)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-1.2769	0.8033	2.5270	0.1119	.	0.279
MALE	1	0.9130	0.6219	2.1556	0.1421	0.056858	2.492
WHITE	1	1.1507	0.4491	6.5650	0.0104	0.098423	3.160
FFGE	1	-0.1462	0.2463	0.3525	0.5527	-0.026297	0.864
SCHOLAR	1	0.4062	0.2384	2.9040	0.0884	0.079803	1.501
HIQUAL	1	-0.0386	0.2642	0.0214	0.8837	-0.006521	0.962
USNA	1	0.2240	0.1713	1.7099	0.1910	0.060512	1.251
PRIENL	1	-0.1590	0.4605	0.1192	0.7299	-0.014805	0.853
TECHMAJ	1	-0.1378	0.1690	0.6650	0.4148	-0.036949	0.871
MARRIED	1	0.3857	0.3548	1.1818	0.2770	0.076269	1.471
KIDS	1	0.1903	0.3000	0.4025	0.5258	0.043534	1.210

Association of Predicted Probabilities and Observed Responses

Concordant = 52.6%	Somers' D = 0.134
Discordant = 39.2%	Gamma = 0.146
Tied = 8.2%	Tau-a = 0.053
(142272 pairs)	c = 0.567

TABLE A.5.E LOGIT RESULTS FOR COMMANDER DATA SET - NAVAL FLIGHT OFFICERS DRAWDOWN PERIOD (1990-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
NAVAL FLIGHT OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 468
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	282
2	1	186

WARNING: 363 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	630.953	637.277	.
SC	635.101	682.910	.
-2 LOG L	628.953	615.277	13.676 with 10 DF (p=0.1883)
Score	.	.	13.585 with 10 DF (p=0.1928)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.1805	1.0151	0.0316	0.8589	.	0.835
MALE	1	0.1268	0.8496	0.0223	0.8814	0.007870	1.135
WHITE	1	-0.00094	0.5337	0.0000	0.9986	-0.000094537	0.999
FFGE	1	-0.3903	0.2551	2.3408	0.1260	-0.083419	0.677
SCHOLAR	1	0.1401	0.2898	0.2336	0.6288	0.026028	1.150
HIQUAL	1	0.1969	0.2912	0.4571	0.4990	0.037574	1.218
USNA	1	0.5689	0.2257	6.3543	0.0117	0.146004	1.766
PRIENL	1	0.1135	0.5975	0.0361	0.8494	0.010291	1.120
TECHMAJ	1	-0.2821	0.2233	1.5958	0.2065	-0.070681	0.754
MARRIED	1	0.2525	0.4091	0.3811	0.5370	0.052727	1.287
KIDS	1	0.4884	0.3573	1.8685	0.1716	0.117064	1.630

Association of Predicted Probabilities and Observed Responses

Concordant = 54.6%	Somers' D = 0.173
Discordant = 37.3%	Gamma = 0.189
Tied = 8.1%	Tau-a = 0.083
(52452 pairs)	c = 0.587

TABLE A.5.F LOGIT RESULTS FOR COMMANDER DATA SET - FLEET SUPPORT AND SUPPLY OFFICERS DRAWDOWN PERIOD (1990-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
FLEET SUPPORT AND SUPPLY OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 941
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	588
2	1	353

WARNING: 50 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	1247.190	1163.191	.
SC	1252.037	1216.508	.
-2 LOG L	1245.190	1141.191	103.998 with 10 DF (p=0.0001)
Score	.	.	99.359 with 10 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.0481	0.2993	0.0258	0.8724	.	0.953
MALE	1	0.1380	0.1722	0.6421	0.4229	0.037374	1.148
WHITE	1	-0.2466	0.2650	0.8663	0.3520	-0.036617	0.781
FFGE	1	1.2339	0.1543	63.9509	0.0001	0.337100	3.434
SCHOLAR	1	0.1616	0.1595	1.0256	0.3112	0.041499	1.175
HIQUAL	1	0.5107	0.2447	4.3565	0.0369	0.084467	1.666
USNA	1	0.3333	0.3785	0.7753	0.3786	0.039231	1.396
PRIENL	1	-0.6837	0.1879	13.2402	0.0003	-0.145101	0.505
TECHMAJ	1	-0.6272	0.2996	4.3841	0.0363	-0.081167	0.534
MARRIED	1	0.4006	0.2248	3.1754	0.0748	0.092786	1.493
KIDS	1	0.3168	0.2091	2.2947	0.1298	0.085713	1.373

Association of Predicted Probabilities and Observed Responses

Concordant = 67.9%	Somers' D = 0.387
Discordant = 29.2%	Gamma = 0.399
Tied = 2.9%	Tau-a = 0.182
(207564 pairs)	c = 0.693

TABLE A.6.A LOGIT RESULTS FOR CAPTAIN DATA SET - POOLED DESIGNATORS
DRAWDOWN PERIOD (1990-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
POOLED DATA SET

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 2059
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	1080
2	1	979

WARNING: 437 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	2851.424	2843.146	.
SC	2857.054	2905.076	.
-2 LOG L	2849.424	2821.146	28.277 with 10 DF (p=0.0016)
Score	.	.	28.057 with 10 DF (p=0.0018)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.2405	0.3494	0.4737	0.4913	.	0.786
MALE	1	-0.1599	0.2227	0.5155	0.4728	-0.020902	0.852
WHITE	1	-0.1368	0.2907	0.2216	0.6378	-0.011615	0.872
FFGE	1	0.0346	0.1015	0.1160	0.7334	0.008475	1.035
SCHOLAR	1	0.3729	0.1306	8.1471	0.0043	0.072743	1.452
HIQUAL	1	0.2431	0.1616	2.2636	0.1324	0.038341	1.275
USNA	1	0.2961	0.1006	8.6669	0.0032	0.078184	1.345
PRIENL	1	-0.3952	0.2626	2.2655	0.1323	-0.037825	0.674
TECHMAJ	1	-0.0583	0.1077	0.2932	0.5882	-0.014067	0.943
MARRIED	1	0.3994	0.2409	2.7472	0.0974	0.070028	1.491
KIDS	1	0.4988	0.2226	5.0189	0.0251	0.103196	1.647

Association of Predicted Probabilities and Observed Responses

Concordant = 52.1%	Somers' D = 0.130
Discordant = 39.2%	Gamma = 0.142
Tied = 8.7%	Tau-a = 0.065
(1057320 pairs)	c = 0.565

TABLE A.6.B LOGIT RESULTS FOR CAPTAIN DATA SET - SURFACE WARFARE OFFICERS
DRAWDOWN PERIOD (1990-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
SURFACE WARFARE OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 614
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	338
2	1	276

WARNING: 39 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	846.913	849.654	.
SC	851.333	893.854	.
-2 LOG L	844.913	829.654	15.260 with 9 DF (p=0.0840)
Score	.	.	14.904 with 9 DF (p=0.0936)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-0.9027	0.7336	1.5140	0.2185	.	0.405
MALE	0	0	.	.	.	.	.
WHITE	1	0.1866	0.5927	0.0991	0.7529	0.014252	1.205
FFGE	1	-0.0529	0.1818	0.0846	0.7711	-0.014061	0.948
SCHOLAR	1	0.7408	0.2846	6.7740	0.0092	0.127453	2.098
HIQUAL	1	0.0981	0.3114	0.0994	0.7526	0.015208	1.103
USNA	1	0.1994	0.1759	1.2852	0.2569	0.054614	1.221
PRIENL	1	-0.6251	0.4767	1.7193	0.1898	-0.061229	0.535
TECHMAJ	1	-0.0376	0.1974	0.0364	0.8487	-0.009172	0.963
MARRIED	1	1.1805	0.5213	5.1287	0.0235	0.181362	3.256
KIDS	1	0.8000	0.4401	3.3042	0.0691	0.145376	2.226

Association of Predicted Probabilities and Observed Responses

Concordant = 54.4%	Somers' D = 0.174
Discordant = 37.0%	Gamma = 0.191
Tied = 8.6%	Tau-a = 0.086
(93288 pairs)	c = 0.587

TABLE A.6.C LOGIT RESULTS FOR CAPTAIN DATA SET - SUBMARINE OFFICERS
DRAWDOWN PERIOD (1990-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
SUBMARINE OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 209
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	143
2	1	66

WARNING: 36 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	262.688	265.139	.
SC	266.030	295.220	.
-2 LOG L	260.688	247.139	13.549 with 8 DF (p=0.0943)
Score	.	.	13.908 with 8 DF (p=0.0842)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-1.8736	1.2881	2.1155	0.1458	.	0.154
WHITE	0	0	.	.	.	.	.
FFGE	1	0.3390	0.6962	0.2371	0.6263	0.043582	1.404
SCHOLAR	1	0.2801	0.3190	0.7709	0.3799	0.077195	1.323
HIQUAL	1	0.2315	0.5877	0.1551	0.6937	0.035888	1.260
USNA	1	0.9212	0.3608	6.5191	0.0107	0.238526	2.512
PRIENL	1	-0.2752	1.4827	0.0344	0.8528	-0.014805	0.759
TECHMAJ	1	0.00839	0.3540	0.0006	0.9811	0.002030	1.008
MARRIED	1	1.6110	1.2823	1.5784	0.2090	0.288923	5.008
KIDS	1	1.9751	1.2155	2.6403	0.1042	0.377329	7.207

Association of Predicted Probabilities and Observed Responses

Concordant = 59.0%	Somers' D = 0.299
Discordant = 29.0%	Gamma = 0.340
Tied = 12.0%	Tau-a = 0.130
(9438 pairs)	c = 0.650

TABLE A.6.D LOGIT RESULTS FOR CAPTAIN DATA SET - PILOTS
DRAWDOWN PERIOD (1990-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
PILOTS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 647
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	343
2	1	304

WARNING: 112 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	896.580	908.054	.
SC	901.053	957.249	.
-2 LOG L	894.580	886.054	8.527 with 10 DF (p=0.5775)
Score	.	.	8.388 with 10 DF (p=0.5910)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	0.5375	1.4369	0.1400	0.7083	.	1.712
MALE	1	-0.9648	1.1798	0.6688	0.4135	-0.041726	0.381
WHITE	1	0.0627	0.6430	0.0095	0.9223	0.004268	1.065
FFGE	1	0.0292	0.2439	0.0144	0.9046	0.005505	1.030
SCHOLAR	1	0.2067	0.3522	0.3445	0.5572	0.026484	1.230
HIQUAL	1	0.4721	0.3083	2.3444	0.1257	0.071435	1.603
USNA	1	0.0339	0.1768	0.0368	0.8479	0.008823	1.034
PRIENL	1	-0.1063	0.6420	0.0274	0.8685	-0.007236	0.899
TECHMAJ	1	-0.3688	0.2066	3.1849	0.0743	-0.083565	0.692
MARRIED	1	0.3823	0.5524	0.4790	0.4889	0.065933	1.466
KIDS	1	0.5273	0.5039	1.0950	0.2954	0.099739	1.694

Association of Predicted Probabilities and Observed Responses

Concordant = 47.2%	Somers' D = 0.115
Discordant = 35.8%	Gamma = 0.138
Tied = 17.0%	Tau-a = 0.057
(104272 pairs)	c = 0.557

TABLE A.6.E LOGIT RESULTS FOR CAPTAIN DATA SET - NAVAL FLIGHT OFFICERS
DRAWDOWN PERIOD (1990-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
NAVAL FLIGHT OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 175
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	65
2	1	110

WARNING: 242 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	232.899	235.463	.
SC	236.064	267.111	.
-2 LOG L	230.899	215.463	15.436 with 9 DF (p=0.0796)
Score	.	.	13.729 with 9 DF (p=0.1323)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-49.5716	0.2679	34228.9551	0.0001	.	0.000
MALE	0	0	.	.	.	.	.
WHITE	0	23.6816	.	.	.	.	999.000
FFGE	1	-0.1547	0.4344	0.1267	0.7218	-0.035906	0.857
SCHOLAR	1	1.0188	0.5719	3.1735	0.0748	0.157691	2.770
HIQUAL	1	1.1268	0.5313	4.4978	0.0339	0.202457	3.086
USNA	1	0.3495	0.3643	0.9203	0.3374	0.093646	1.418
PRIENL	1	-0.4025	1.1854	0.1153	0.7342	-0.037075	0.669
TECHMAJ	1	-0.1344	0.4153	0.1047	0.7463	-0.032930	0.874
MARRIED	1	24.3704	0.6151	1569.8349	0.0001	3.990543	999.000
KIDS	0	25.1939	.	.	.	.	999.000

Association of Predicted Probabilities and Observed Responses

Concordant = 58.7%	Somers' D = 0.297
Discordant = 29.0%	Gamma = 0.339
Tied = 12.4%	Tau-a = 0.140
(7150 pairs)	c = 0.649

TABLE A.6.F LOGIT RESULTS FOR CAPTAIN DATA SET - FLEET SUPPORT AND SUPPLY OFFICERS DRAWDOWN PERIOD (1990-1994)

LOGIT REGRESSION PROMOTE ON SELECTED VARIABLES
FLEET SUPPORT AND SUPPLY OFFICERS

Data Set: WORK.ALL
Response Variable: LOGPROM
Response Levels: 2
Number of Observations: 414
Link Function: Logit

Response Profile

Ordered Value	LOGPROM	Count
1	0	191
2	1	223

WARNING: 8 observation(s) were deleted due to missing values for the response or explanatory variables.

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	573.450	570.996	.
SC	577.476	615.280	.
-2 LOG L	571.450	548.996	22.454 with 10 DF (p=0.0130)
Score	.	.	21.896 with 10 DF (p=0.0156)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	0.4346	0.4769	0.8307	0.3621	.	1.544
MALE	1	-0.5061	0.3258	2.4140	0.1203	-0.126444	0.603
WHITE	1	-0.5937	0.4311	1.8964	0.1685	-0.079512	0.552
FFGE	1	0.8586	0.2159	15.8131	0.0001	0.236504	2.360
SCHOLAR	1	-0.3601	0.2610	1.9041	0.1676	-0.080640	0.698
HIQUAL	1	-0.2509	0.3524	0.5071	0.4764	-0.040920	0.778
USNA	1	0.1035	0.3532	0.0859	0.7695	0.016877	1.109
PRIENL	1	-0.2007	0.4231	0.2250	0.6353	-0.027353	0.818
TECHMAJ	1	-0.6443	0.4399	2.1453	0.1430	-0.086287	0.525
MARRIED	1	0.0732	0.3657	0.0400	0.8414	0.015140	1.076
KIDS	1	0.0693	0.3731	0.0345	0.8527	0.017926	1.072

Association of Predicted Probabilities and Observed Responses

Concordant = 59.4%	Somers' D = 0.251
Discordant = 34.4%	Gamma = 0.267
Tied = 6.2%	Tau-a = 0.125
(42593 pairs)	c = 0.625

APPENDIX B. CHOW TEST RESULTS

The Chow test (Gujarati, 1988) is a method to test for differences between two or more OLS regression equations. It consists of combining the N_1 and N_2 observations of the two (or more) categories and running a single, "pooled" OLS regression. From this regression, obtain the residual sum of squares (RSS), called S_1, with degrees of freedom (df) = $N_1 + N_2 - k$, where k is the number of parameters estimated. Perform these same procedures for each of the individual regressions and obtain their RSS's (S_2 and S_3) with df= $N_1 - k$ and $N_2 - k$, respectively. Sum these RSS's to form S_4 which will have df = $N_1 + N_2 - 2k$. Obtain a difference RSS (S_5) by subtracting S_4 from S_1. Then apply the F test as follows:

$$F_{computed} = \frac{(S_5 / k)}{S_4 / (N_1 + N_2 - 2k)} \quad \text{with df} = k, N_1 + N_2 - 2k.$$

If the computed F exceeds the critical F (from F distribution tables), reject the hypothesis that the two regressions are the same. (Gujarati, p. 444)

Table B.1.B presents the data used to compute F values for all Chow tests performed in this thesis.

	S1	k1	S2	k2	N1	S3	k3	N2	S4	S5	Fcomp
CDR	1948.343	10	1160.018	10	6219	777.856	10	3741	1937.873	10.469	5.37
CDR SWO	533.644	10	323.528	10	1698	208.411	10	1017	531.939	1.705	0.864
CDR SUB	129.629	9	53.204	9	519	73.930	9	462	127.135	2.494	2.099
CDR PILOT	567.716	10	401.782	10	2221	163.857	10	851	565.638	2.078	1.121
CDR NFO	222.279	10	108.316	9	560	108.824	10	467	217.140	5.139	2.386
CDR SUPP	450.354	10	247.339	10	1217	197.287	10	940	444.626	5.728	2.753
CAPT	972.257	10	462.803	10	1912	506.514	10	2058	969.317	2.939	1.198
CAPT SWO	272.359	9	118.813	9	512	148.247	9	613	267.060	5.300	2.441
CAPT SUB	97.757	9	53.744	9	268	42.153	8	208	95.897	1.860	0.989
CAPT PILOT	337.812	10	176.476	9	726	159.073	10	646	335.549	2.263	0.912
CAPT NFO	74.076	9	31.720	9	149	37.652	9	174	69.372	4.704	2.298
CAPT SUPP	158.055	10	57.977	9	253	97.404	10	413	155.418	2.637	1.098

Table B.1.B F-computations for Chow tests

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